Radio, Electronics and Communications

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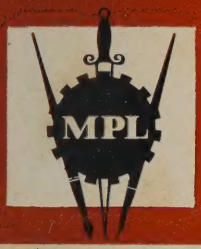

In This Issue . . .

- Relays V. Semiconductors
- V.H.F. Aerials
- Simple Transistorised Convertor
- A Versatile Regulated Power Supply
- Circuit and Service Data
- Serviceman's Column

PUBLISHED MONTHLY IN THE INTERESTS OF THE N.Z. ELECTRONICS INDUSTRY FOR ALL LEVELS, FROM PROFESSIONAL TO AMATEUR.

VOLUME 19 NUMBER 7

SEPTEMBER 1, 1964

PRICE 2/6

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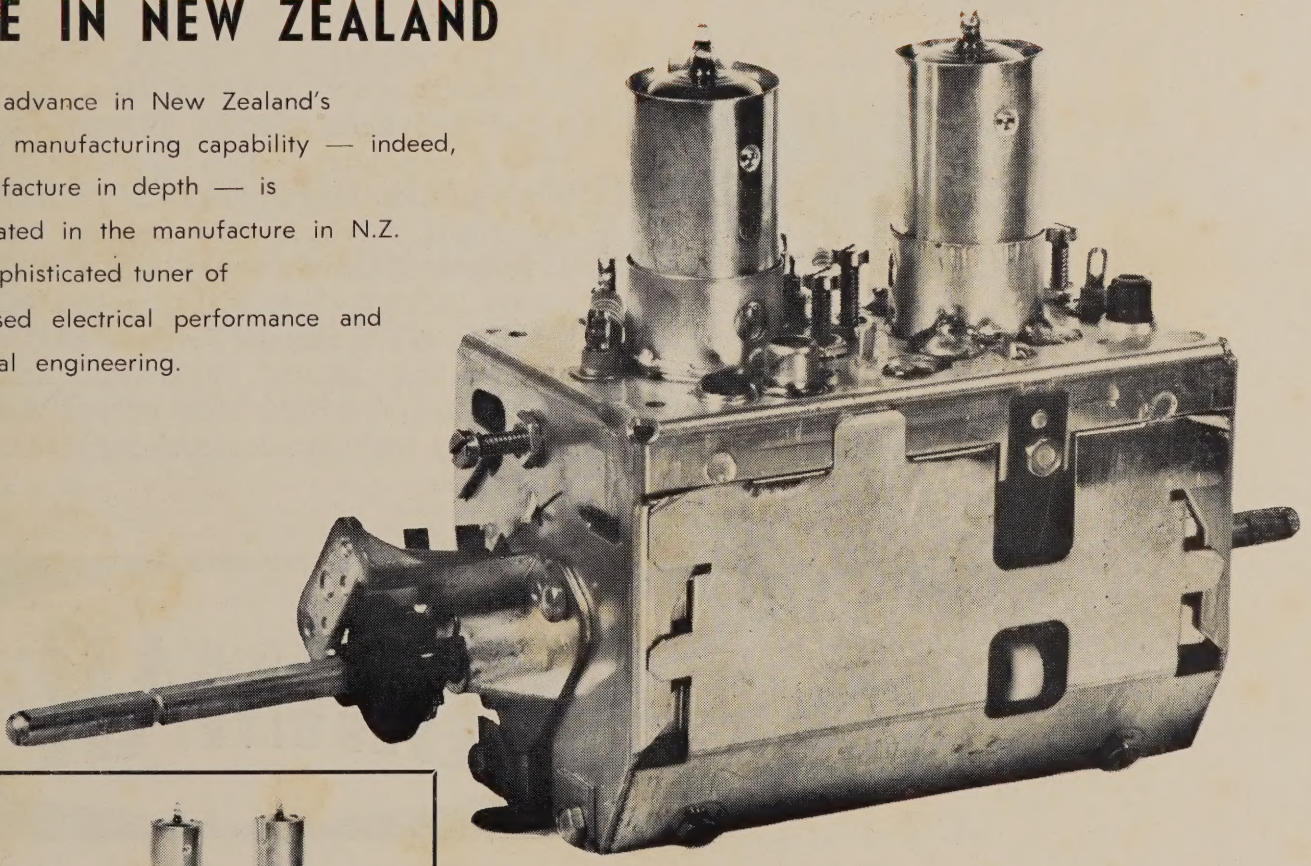

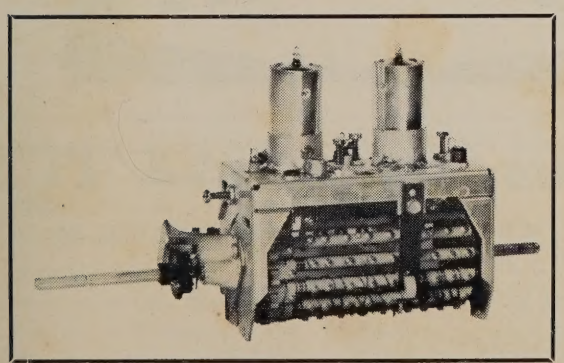

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ENQUIRY CARD AD. 1

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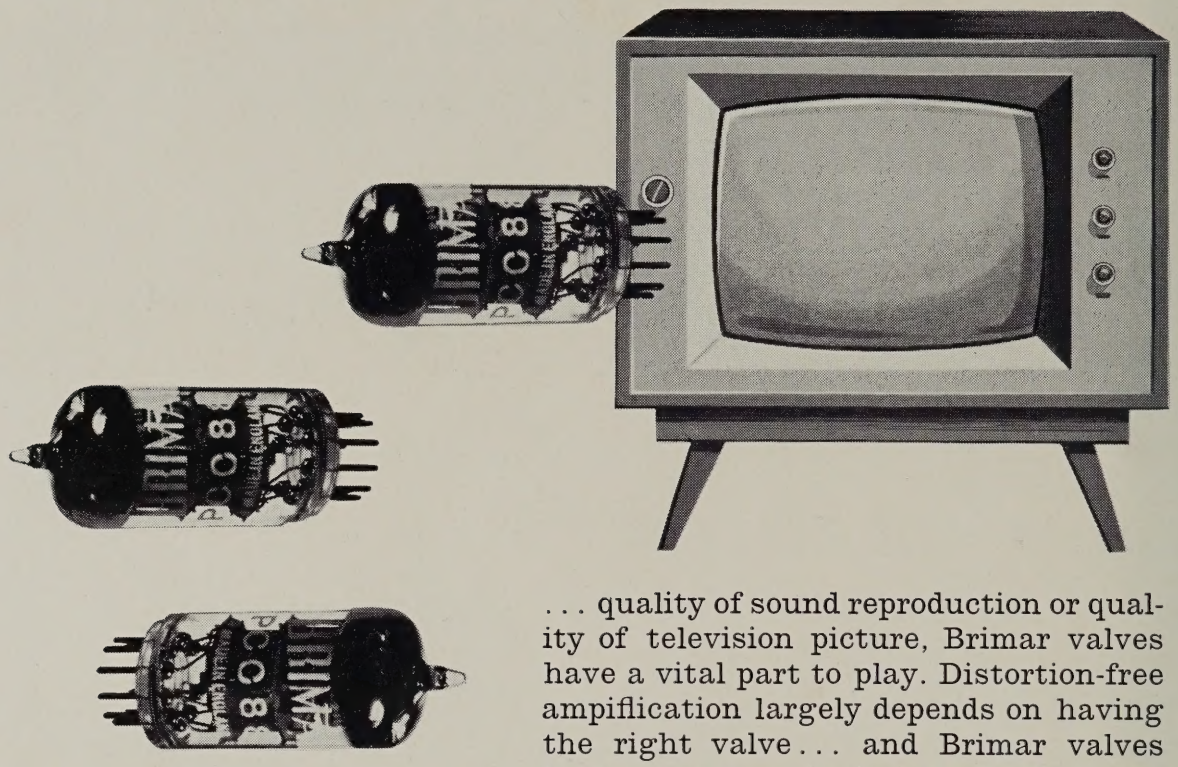

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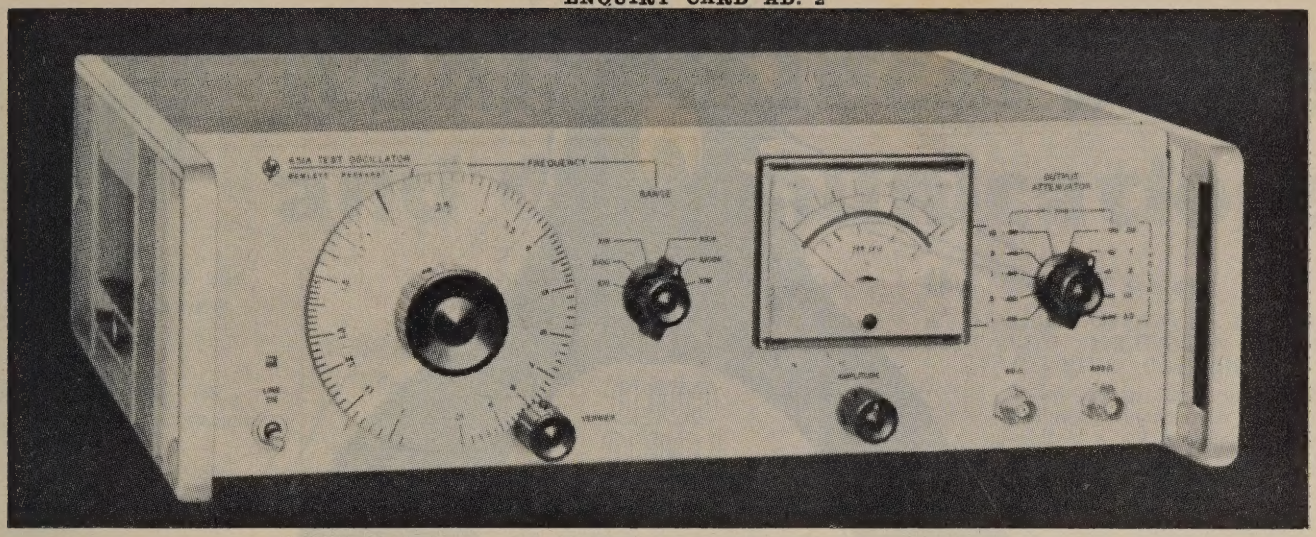
ENQUIRY CARD AD. 2



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Distortion: Less than 1%, 10 cps to 5 mc; approx. 2% at 10 mc
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Radio, Electronics and Communications

Formerly Radio and Electrical Review
(Established 1946)

OFFICIAL JOURNAL OF
The New Zealand Electronics Institute (Inc.)
Secretary: J. L. McKie, P.O. Box 1506, Christchurch.

CONSULTANT EDITORS:
C. W. Salmon, M.N.Z.I.E., Grad. I.E.E., Assoc. I.E.R.E.
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P. L. Watts representing N.Z. Electronics Institute

EXECUTIVE EDITOR:
Robin H. E. Beckett.

* * *

Published Monthly by the Proprietors:
THE MAGAZINE PRESS LTD.,
Publishers also of HOME AND BUILDING

Director and Chairman:
Victor L. Beckett A.A.I.(Aust.), Hon.A.N.Z.I.A.

Director and Secretary:
Wilma W. Beckett

Production Manager:
Robin H. E. Beckett, B.A.

at the Registered office of the company: Lumley House, 10 High Street, Auckland, C.1., N.Z. P.O. Box 1365, Auckland. Telephone 41-508, 41-519.

* * *

Sole New Zealand Distributors: GORDON & GOTCH (N.Z.) LTD.

From Newsagents — 2/6 per copy. Or direct from the publishers 30/- per year in advance, post free throughout the world.

* * *

Advertising Representatives for the United Kingdom:
PUBLISHING & DISTRIBUTING CO., LTD.,
177 Regent St., London, W.1.

* * *

Printed by Farrell Printing Ltd., Mt. Roskill, Auckland. Registered as a newspaper at the G.P.O., Wellington.

Vol. 19, No. 7 September 1, 1964

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FEATURED NEXT MONTH . . .

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A Transistorised Amplifier
Making the Most of Technical Periodicals

On Our Cover

A MAJOR ADVANCE IN NEW ZEALAND'S TELEVISION MANUFACTURING CAPABILITY

The production in this country of a Television Tuner, which is the most complex sub-unit in a TV receiver to manufacture, is a major step forward for New Zealand's fledgling Television industry.

The new Turret Tuner illustrated on the front cover exemplifies the most advanced state of the art. It is supplied fitted with coil assemblies for the nine channels already allocated to television in New Zealand, and there are five spare positions.

These additional channels can be brought into operation simply by inserting appropriate coil assemblies. A combination of well-executed electronic and mechanical engineering accounts for the superior performance of this tuner. It is being manufactured by Allied Industries Limited, Auckland, under licence to Amalgamated Wireless (Australasia) Limited.

The fine tuning control is of a pre-set type which adjusts each channel individually. The frequency stability of the tuner is such that once the fine tuning control has been set up correctly, no further adjustment will be necessary for long periods.

All contact working surfaces are silver and the contacts are hard gold flashed to protect them from contamination during manufacture.

The tuner is effectively shielded. The side covers can be removed without affecting the response curve or oscillator frequency. With side covers removed coil assemblies can be quickly and easily withdrawn or inserted.

Accessories are available to convert the basic tuner for concentric or off-set fine tuning. Nylon gears are employed for mechanical smoothness.

In choosing this tuner for local manufacture, Allied Industries Limited assures for its own receiver production a component of superior quality and performance.

Commencing April 1965, the company plans to mass produce the tuner to meet the demands of other TV receiver manufacturers who desire to conserve overseas exchange and increase the depth of local manufacture. The usual lead time of approximately six months has been set down by the factory to permit forward production planning.

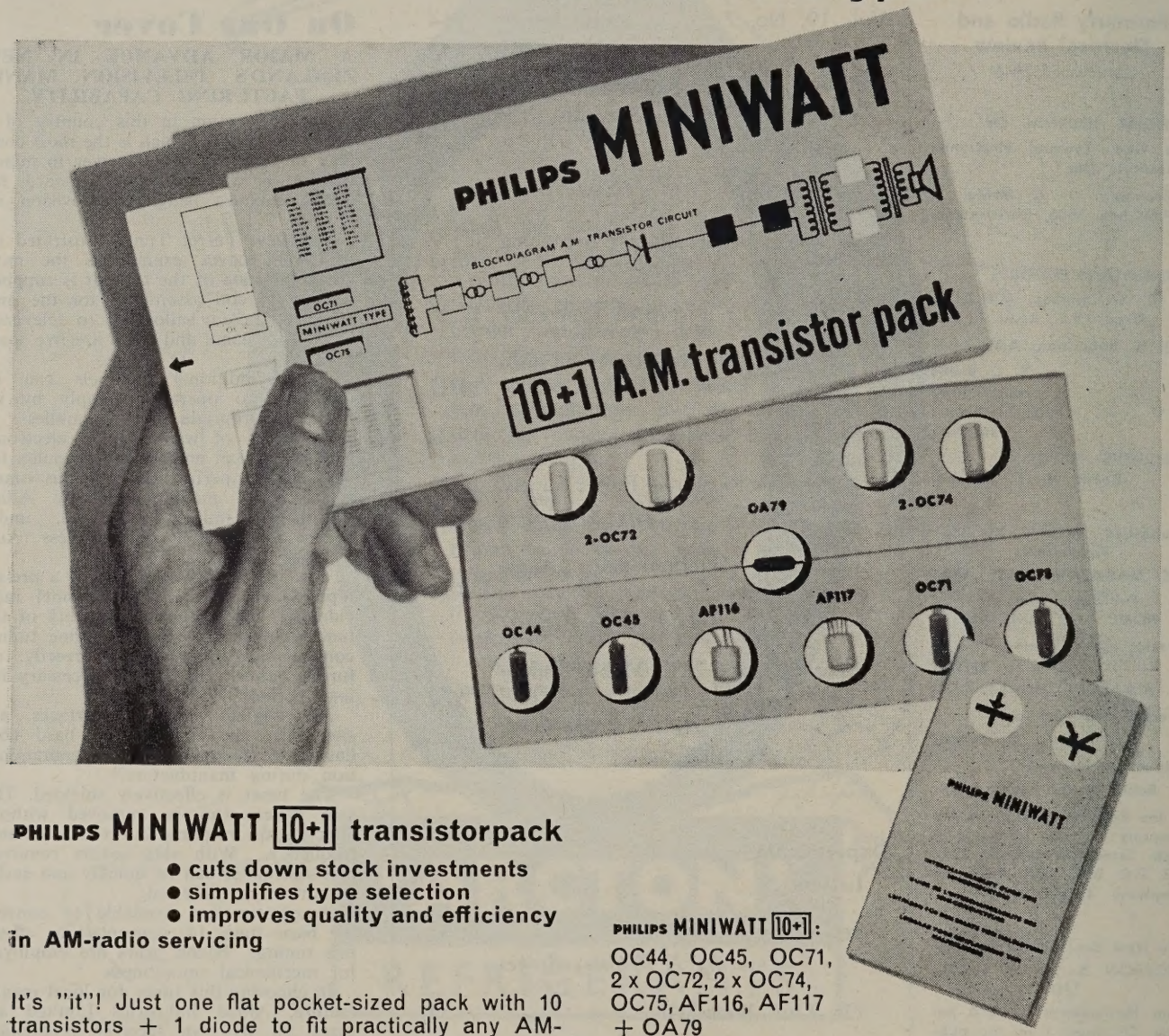
The technical acceptance of this new product is underlined by the experience of A.W.A. in Australia. In that country four major manufacturers have already adopted this new tuner.

ENQUIRY CARD AD. 4

ENQUIRY CARD AD. 5

New!

PHILIPS 10+1 AM transistor pack offers 11 semiconductors of equipment-quality to replace 350 different types



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ENQUIRY CARD AD. 6

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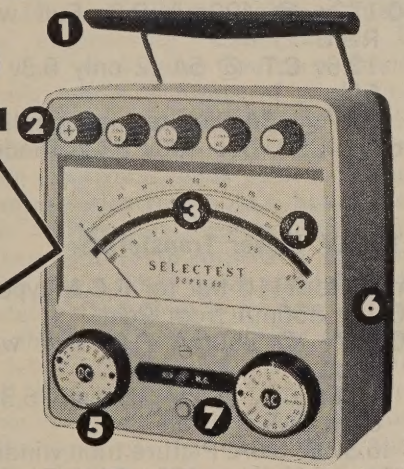

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7. Automatic overload cut-out.

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AUCKLAND BRANCH

The Auckland Branch of the N.Z.E.I. are holding a meeting on the 12th October, at 7.45 p.m., in the Lecture Room No. 3 of the Auckland University College Physics Department, and extend an invitation to all interested.

This meeting will consist of a symposium on television servicing in which the various views of the manufacturer, serviceman, and service agent will be presented by a panel of four able speakers.

Time has been allowed for questions and the committee feel many interesting points will arise regarding this very topical subject.

N.Z.A.R.T.

HAMILTON BRANCH

The Hamilton Branch N.Z.A.R.T. is holding their third Mobile Rally in Hamilton on Saturday and Sunday, 24th and 25th October (Labour Weekend). Novelty items include a V.H.F. Sniftor Hunt, Hidden Transmitter Hunt and Mobile Contest. For further information contact ZL1CS Colin Shaw, P.O. Box 636, Hamilton. Registration fee for weekend is 35/- per person.

R.C.A.

R.C.A. of Australia inform us that the License Service Laboratories of the Radio Corporation of America will be holding a Technical Symposium in Auckland on 23rd October. Three lecturers are coming from the R.C.A. Laboratory in Zurich for about a week. Mr. Stephen Barone, Vice-President, License Operations, will also be present.

The several talks will centre around "Receiver Design and Methods of Measurement." We hope to be able to publish some notes from this Symposium and also a statement from Mr. Barone.

ENQUIRY CARD AD. 7

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R98 T.V. POWER TRANSFORMER

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230:115v A.C. @ 300mA D.C.
:12.6v C.T. @ 5A (2 windings ea. 6.3 @ 5A).
:0—6.3—7.5—9 @ .6A. Picture tube winding.
Choke:—C36. Use 400v P.I.V. Diodes.

R103 Stereo Power Transformer

R.T.V. & H. Aug. 60. 7w Stereo.
230:245v @ 150mA. D.C.
:104v @ 150mA D.C. Voltage doubler Rect.
:6.3v C.T. @ 5A.
Choke:—C42. Use 400v P.I.V. Diodes.

R104 Stereo Power Transformer. 10w

320v @ 320mA. Voltage doubler Rect.
230:130v @ 320mA.
:6.3v @ 6A.
Choke:—C49. Use 500v P.I.V. Diodes.

R105 T.V. Power Transformer For Philips T.V. Kitsets

220v @ 420mA D.C. Voltage Doubler Rect.
230:106v @ 420mA D.C.
:6.3v @ 10A.
:0—6.3—7.5—9 Ov @ 0.3A. Picture tube Winding.
Choke:—C45. Use 400v P.I.V. Diodes.

R106 T.V. Power Transformer for Philips T.V. Kitsets

This type similar to R105 but less Picture Tube boost taps. Main Fils. 12.6v C.T. @ 5A.
220v @ 420mA D.C. Voltage Doubler Rect.
230:106v @ 420mA D.C.
:12.6v C.T. @ 5A (2 windings 6.30v @ 5A each).
:6.3v @ .3A Picture tube winding.
Choke:—C45. Use 400v P.I.V. Diodes.

R108 Small Stereo Headphone Power Transformer

250v @ 22mA D.C.
230:110v @ 22mA D.C. Voltage doubler Rect.
:6.3 @ 0.86A.
Choke:—C41. Use 400v P.I.V. Diodes.

R110 T.V. Power Transformer. For Philips T.V. Kitsets

This transformer uses full wave bridge rectifier. Requires no limiting resistor unlike equivalent voltage double types, also has advantage of no insulated capacitor and lower ripple output with smaller choke.
Output 220v @ 420mA D.C.
230:172v @ 420mA D.C. Full wave bridge Rect:
:12.6v C.T. @ 5A (2 only 6.3v winding @ 5A).
:6.3v @ .3A Picture tube winding.
Choke:—C50. Use 400v P.I.V. Diodes.

R111 T.V. Power Transformer

Similar to R110 but for R.C.A. type Kitsets.
260v @ 350mA from Rect.
230:207v @ 350mA D.C. Full wave bridge Rect.
:12.6v C.T. @ 5A (2 only 6.3v windings each 5A).
:6.3v @ 0.6A. Picture tube winding.
Choke:—C42. Use 400v P.I.V. Diodes.

R112 Oscilloscope Power Transformer

R.T.V. & H. 1963. Calibrated.
230:110v @ 80mA D.C. Full wave voltage doubler.
:6.3v @ 2.4A.
:6.3v @ 1A.
:6.3v @ 1A.
Use 400v P.I.V. Diodes.

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THE SPECIALIST NON SPECIALIST!

Two recent editorials* point to the dangers of narrow specialisation, particularly in an expanding economy. The August editorial dealt with the problem of companies faced with the loss of orders or outlets due to State action, and the September 1963 editorial reported the thoughts of an eminent educationalist, saying that the specialist, whilst essential, should have broad general knowledge outside his special field.

However efficient (and ruthless) no company relishes the prospects of sacking staff due to loss of contracts—the good ones look for other outlets. What outlets are available depend upon the versatility of the company and its top engineering management. In America the loss of defence contracts found companies with whole sections of high professional competence completely unemployable. These same companies have entered, or wish to enter, other electronic fields such as industrial or consumer electronics but have been frustrated in employing "redundant" staff because of their failure to approach the new field open-mindedly. They have specialists in one field—outside that they were lost. They had lost the ability to tackle a new problem on a broad level. What happened to them is, indeed, all they deserved. Defence work paid good money—very good money in most cases—and the lure of the quick buck has taken its toll. It is a truism that all good things come to an end and in the competitive technical field in America job security is no catch word but in hundreds of cases the fat pay packet outweighed the future and the pay packet was that of a specialist specialist living, as it turned out, on borrowed time.

That one has to be a specialist, nowadays, is essential but, as Sir Willis Jackson points out, one has also to be a good non-specialist. This is where many of the engineers affected by the defence cuts in America failed. Many reports in the American technical press indicate the former employers would readily have kept them on had they been able to change their attack to, say, industrial electronics. Several companies seriously hurt by the cuts have successfully entered the industrial field—it is interesting, in passing, to note that this field is far more exploited in Great Britain. In many cases they have taken on young engineers with little previous experience because of their inherent adaptability.

This has happened overseas—can it happen in this country? Probably not on the same level as little military electronic work is done here. Nevertheless, our economy is by no means assured of a rosy future. Whilst television sales continue to boom credit restrictions on hire purchase could overnight change the scene—in any case city saturation will occur in a few years' time and country sales require greater sales effort and thus less profit. Colour television is the next sales boost to counter this. But what if no colour television because of the state of our finances? How many television technicians and engineers could design an electric fence or pH meter to aid primary production, or develop an electronically controlled sawmill programme system? Six or twelve perhaps. By now some readers will be saying, "it couldn't happen here"—well, it happened in the U.S.A., with the highest military spending in the Western world.

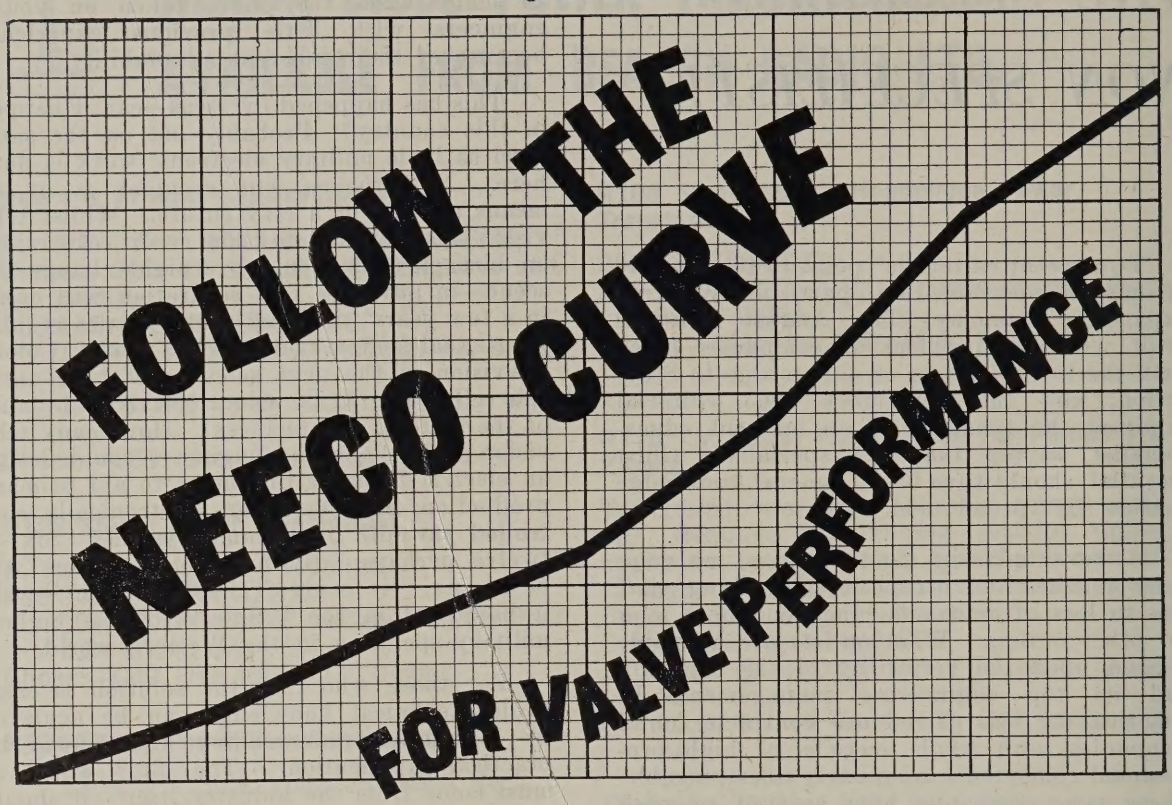
For those who care the solution is easy. Wider technical knowledge can be achieved by instruction and reading and helped by practical application. The first approach must come from the industry itself—it should wish to be adaptable and versatile and so be flexible enough to cope with any future changes due to economic pressures. The people in it must **now** be prepared to give up time to look at, and study, other aspects of their profession. Sufficient interested and keen Technical Institutes at the four main centres could provide courses of a term's length designed to broaden the competence of, say, television and radio production personnel into industrial controls. Industrial electronics, our choice of an example, only uses electronics as a **method** of control. It involves the knowledge of the characteristics and behaviour of both static and rotating plant—electrical and mechanical—the dynamics of a machine is more important than whether an OC35 transistor or an EL84 is used to control the D.C. in a saturable reactor.

The leaders of the industry should lead the way, if need be, by giving time off **in working hours** to such courses and by ensuring that the Technical Institutes provide the courses. Allied to this, or as a part of it, should be refresher courses every two or three years to keep abreast of trends. How many designers trained in the 1940's are "tops in transistors" or how many New Zealand electrical and radio engineers trained in the 1950's are completely at home with D.C. machines.

—C. W. S.

* "This Changing Industry," August 1964.
"The Visit of Sir Willis Jackson," September 1963.

ENQUIRY CARD AD. 8



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V2.1

Relays Versus Semiconductor Switching Devices— a Comparison . . .

This article is based on a paper presented by Mr. L. W. D. Sharp* to The Conversazione on Relays held at R.R.E. Malvern recently.

From time to time it is suggested that with intensive development of solid-state switching devices, the electro-mechanical relay will no longer be required. While it is true that semi-conductor switching has many outstanding advantages, such sweeping generalisations cannot be accepted at their face value. Any consideration of the future requirements for relays in electronic equipment must, however, take into account the areas in which solid-state devices will predominate. No organisation can support the time, effort and expenditure required to develop a new relay to the standard of performance and reliability expected from modern components unless a production life of many years is assured.

In comparing the electro-mechanical relay with the solid-state device, it is necessary to consider the operating parameters relevant to any particular application. The principal parameters are as follows:—

Size and weight.
Reliability.
Power rating.
Sensitivity.
Operating speed.
Temperature rating.
Cost.

These points will now be considered in turn.

Size and Weight

It might be thought that a semi-conductor switch is always smaller than a relay performing the same duty, particularly when considering integrated solid circuits. Whilst this is so for simple switching at moderate current ratings, the reverse may be true when a number of independent circuits are to be controlled simultaneously. This aspect will be considered in more detail later.

Reliability

There is little doubt that semi-conductor switching can provide a higher order of reliability than is obtainable with relays, provided suitable precautions are taken to deal with the transistor's two principal enemies, excessive temperature rise and voltage surges.

The expectancy of life of currently available relays ranges from 100,000 to 100,000,000 operations, according to the style of relay and the manner in which the contacts are used. Even the higher figure is obviously inadequate for continuous cycling at switching times in the millisecond range, but it must be remembered that if an equipment is switched on and off four times a day for 10 years, only 15,000 operations are performed. Even where relays are used for selection of equipment function, e.g., transmitter-receiver channel change or telephone circuit routing, day and night operation every five minutes for 10 years will still result in only about one million operations. Thus the relay is still capable of performing many functions in military and industrial electronics with an acceptable life-span.

It must be recognised, however, that very little genuine data exists on which could be based the concept of a relay with a guaranteed life as opposed to an average life expectancy. Information on which to base such a guarantee must be obtained under controlled, specified conditions of test, and testing is needed for long periods with a statistically acceptable number of samples. Moreover, service conditions cannot be simulated by continuous switching at a steady rate. Periods representing equipment out of commission should be interposed between periods of operation if a true assessment is to be made of relay reliability.

English companies are at present studying the problem of reliability assessment on relays and other components and in the meantime much effort has been devoted to improving the reliability and quality standards of current products by design modifications, improved materials and assembly techniques, the provision of clean room and ultrasonic washing facilities, and by systematic batch sampling.

Such measures provide enhanced reliability **now** which can be related to performance in the field, without the lengthy delay and heavy costs involved in conducting a classical failure-rate programme which in itself does nothing to improve the product, but can only provide the data on which to base a further programme of development and process investigation.

It is felt that this practical approach to the elimination of currently known causes of unreliability provides a better return, to user and manufacturer alike, for a given technical effort. The success achieved can then be measured by systematic batch sample tests.

Power Rating

Switching transistors are available for currents ranging from a few milliamps to several amps, and small relays can be used over a similar current range. Dry circuit conditions involve special problems, whether semi-conductors or relays are

* Plessey Ltd., U.K.

used, but techniques are available, and in general it can be said that most requirements can be met by either method.

General purpose relays can be used for power switching up to several hundred volts, and special versions are obtainable rated for 1kV or more but semi-conductors suitable for switching voltages higher than about 50V are difficult to make and are costly. In general it can be said that semiconductor switching can match the relay for ratings up to this voltage, but at higher voltages the relay is economical and more adaptable.

Semiconductor switching of AC circuits is best carried out by controlled rectifiers, but unless conversion to DC is permissible a bridge configuration must be used with associated complication of the drive circuits. On the other hand, G.P. relays can be run at higher ratings with an improved life expectancy on AC circuits. They offer a considerable advantage in size and cost for many applications requiring switching capacities of up to several amps at typical line voltages.

Sensitivity

Precise comparison of the sensitivity of the two types of device is difficult but it is useful to consider the relay as a DC amplifier and assess its power gain as a figure of merit to compare with a transistor switch. Taking representative designs now in production by several relay suppliers we find that miniature G.P. relays can provide gains in the range of 15dB to 38dB. These figures are based on the ratio of nominal input power to maximum rated power on the contracts, and the gain depends both on the size of the relay and the basis of contact rating. Obviously, a given relay with a moderate contact rating has a lower effective gain, but a greater expectancy of life.

Table 1 gives examples of typical relays in the Plessey-UK-Ericsson range, showing the gain and life expectancy which can be achieved. It will be appreciated that the CF type relay, in a volume little more than a quarter cubic-inch, contains the equivalent of two monostable pairs switching 1 amp each, and with the output circuits fully isolated. The input power is less than one watt and is of the same order as the power dissipation of the equivalent transistor switch, after allowing for forward voltage drop in the switching transistors and power consumed by the drive circuits.

The figures given in table 1 are based on the rated operating voltage, and if the coil can be energised under controlled current conditions the input power may be reduced to about one-third, increasing the gain by 5dB. Under such conditions the power dissipation of the relay may be lower than that of the equivalent transistor switch.

On the other hand, the signal power required for transistor switching will be lower than that required for a G.P. relay, and if signal power is limited a sensitive or polarised relay must be used. It is interesting to note that the gain of a sensitive relay is of the same order as that of a G.P. relay of a similar size. This is due to the fact that a reduction of operating power is usually accompanied by a similar reduction in the maximum current handling capacity of the contacts. A sensitive relay may dissipate considerably less power than the equivalent transistor switch and will be its equal in all other respects except operating speed and ultimate endurance.

Operating Speed

The outstanding advantage of the semiconductor switch is that fast and consistent operating speeds can be obtained. Switching times of the order of one micro-second are readily obtained, and devices are now becoming available with times down to about 100 nanoseconds. The fastest relay is obtained by using a reed capsule, but even so the operating time is a few hundred microseconds, and miniature armature relays are about one order slower.

Freedom from contact bounce is another advantage of the semiconductor switch, but correctly used reed relays and high-speed relays can provide satisfactory service for many applications, such as telegraph signalling.

General purpose relays provide adequate operating speed for many applications, such as AC and DC power switching, routing of AF and RF signals, control of equipment function and those types of logic circuit which are associated with process control and other systems where the rate of change is measured in milliseconds rather than microseconds. Relays have even been used successfully for overload protection of transistor circuits.

Temperature Rating

For most switching applications in military equipment, silicon transistors must be used. For short duty cycle applications, the transistor or diode switch may be used at high current ratings; for control circuit switching where the circuit may be energised for long periods, account must be taken of the dissipation due to forward voltage drop. In the case of a transistor switch operating at 100°C or more, allowance must be made for the rise of saturation voltage with temperature, and a considerable reduction of the permissible switch current may be necessary.

In a typical case, a silicon transistor switch can be rated at 500 mA for short duration pulses, but for continuous duty switching at 125°C the rating must be reduced to 140 mA.

The contacts of a relay are not usually subject to such limitations, and provided suitable materials are used in the construction of the coil, relays can be used with full ratings at 125°C.

Cost

The all-important question of cost has been left until last, because it will now be evident that no general rules can be established. Where high and consistent operating speeds are required, com-

parison of cost is unnecessary because the relay cannot meet this requirement.

Where simple on-off switching is required at low currents (up to say 100 mA) the transistor is likely to be less costly, and will have advantages in other respects.

For medium-current low voltage applications, up to say 50V 1 A, the costs may be of the same order provided only single pole switching is required. However, the relay will cost little more when fitted with a four-pole change-over contact configuration, and the added cost of a complex semiconductor network is not justified unless continuous cycling over long periods is required.

Where voltages in excess of 100V must be switched, the relay scores heavily on cost, and where such circuits are associated with power supply circuits requiring a high degree of isolation the relay meets the requirement in an elegant and compact form.

Special mention should also be made of the reed relay. The expected usage of these in telephone exchange equipment will result in production in quantities far higher than could be expected for the armed services alone. As a result, the ultimate cost of a reed capsule is expected to be attractively low. For medium-speed, low-current applications, reed switching will be extremely attractive, and the smaller types now becoming available will be compatible in size with conventional transistor techniques, and capable of a life expectancy of the order of 10^8 operations.

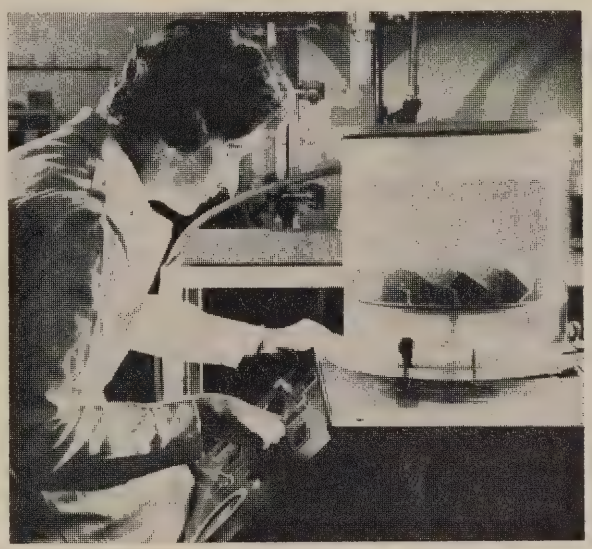
Conclusions

The electro-magnetic relay can be seen to have a continuing future. The semiconductor switch has advantages for particular duties such as very high-speed switching and where continuous cycling over long periods would result in operations in excess of those offered by modern relays; the conventional relay offers a compact and well-proven switching technique with considerable versatility.

The relay excels in its ability to provide a multiplicity of contact configurations and ratings from a single basic design: to provide equivalents by solid-state methods would require the development of a series of complex semiconductor networks each tailored to a particular current/voltage rating.

The semiconductor switch has the advantage of possessing an indefinite life when used under suitable conditions. The absence of the wear-out mechanism found in metallic relay contacts is capable of providing a very high order of reliability. Within the limtations of contact erosion, relays of improved reliability are now available, due to improved design and manufacturing techniques.

There is little to choose between the two devices in relation to gain and power dissipation, and whilst the semiconductor switch may be smaller and cheaper for simple, low-power applications, the reverse will be true for more complex switching functions.



relay cans being checked for air leaks.

TABLE 1. ENDURANCE AND GAIN OF TYPICAL RELAYS

Relay Type	CB			CA		1A	CF	
DEF 5165 style	SM5M			SM5A		SM5B	SM5L	
Volume (cu. in.)	3.2			1.5		1.3	.29	
Weight (oz.)	5			2		2.5	.6	
Operate power (W)	.85			.80		.05	.85	
Contacts	4C			2C	1M	1C	2C	
Contact rating	.1A 300V DC	4A 60V DC	4A 300V AC	3A 24V DC	5A 230V AC	.1A 300V DC	1A 28V DC	3A 28V DC
Endurance	10^7	2×10^5	2×10^5	5×10^5	10^5	10^6	10^6	10^5
Gain (dB)	22	30	38	23	32	28	18	23

Notes: 1. Volume stated is can size excluding terminal pins.
2. Operating power is nominal at rated voltage with allowance for variation of supply voltage and temperature.
3. Contact ratings are as specified in DEF 5165. Manufacturers' ratings are higher in certain cases.
4. Gain is expressed as the ratio of output power capability (per contact set) to input power, multiplied by the number of contact sets provided.

A Simple Transistorised Convertor

Suitable for Home Constructors

Over the past ten years a wide range of battery operated radio and electronic equipment has been imported into New Zealand and, in many cases, no provision has been made for replacement batteries of special types. This situation particularly applies to photographic-flash equipment using 250V and 500 volt H.T. batteries for direct supply to the flash tube capacitor.

The convertor described was built up to replace a 500V H.T. battery in an English photo flash unit. The circuit was designed to incorporate certain components which were on hand. Some brief tests were made to check the possibility of using the basic circuit for other requirements of home constructors. For instance, a 6 volt primary supply was used so that an Elekon-Varley dry accumulator could be used. There is no reason why a 12 volt source cannot be used with the necessary change in the number of turns on the primary. OC30 transistors were used and as these are fairly robust (within the circuit limitations) no difficulty should result from a change to a 12 volt primary.

Similarly, not all requirements will be for a 500 volt D.C. output. Lower outputs can be readily achieved by suitable secondary windings. The unit described has a transformer wound for an alternative output of 90V D.C. to operate a formerly battery-powered shortwave receiver.

The Circuit

The use of transistors in convertors presents a few design problems on account of choice of polarity of operation and insulation of the transistor case (usually the collector). Because it is possible that the unit could be used as a power supply for a conventional (vibrator) car radio positive earth was chosen and thus grounded emitter operation of the transistors was selected. Had this not been a consideration the alternative of grounded collector (negative earth) would have been used as the transistor cases could then have been directly earthed to their heat sinks—in this unit the outside of the convertor chassis.

Figure 1 is a simple form of transistor multivibrator. Assume Tr. 1 conducts first, the collector current will make "collector" end of the transformer primary more positive and feed a voltage through R1 to the base of Tr. 2 cutting this transistor off. The voltage induced in the other half of the primary winding is fed to the base of Tr. 1 through R2 causing further conduction. The increase in Tr. 1 collector current increases until the transformer saturates and the induced voltage to the base of Tr. 1 (via R2) collapses as does Tr. 1 collector current. The sudden collapse of the collector current, however, induces a current of opposite polarity causing negative polarity to appear at the "upper end" of the primary winding and this is applied via R1 to the base of Tr. 2 causing it to conduct. The second cycle then commences as for Tr. 1.

Figure 1 is not a very practical circuit as the base bias voltages are taken from points of relatively high voltage. Because lower voltages are required for the bases the drop in resistors to achieve this can be wasteful and the inherently high conversion efficiency (80%) of transistor convertors can be lost.

As the base drive is both of low voltage and low impedance order a simple way is to provide a second transformer as in figure 2. The second transformer is not of particularly critical design and is usually from 20:1 to 5:1 ratio with the low impedance winding centre tapped as shown. The resistor limits the base current and in a practical circuit is adjusted for maximum efficiency at full load.

A practical objection to the circuit of figure 2 is the need for two transformers with added weight and space requirements.

Figure 3 shows a circuit in which the base current is obtained from a tertiary winding. This circuit is not particularly reliable in operation under load and steps are taken to provide a bias circuit to ensure reliable starting under all conditions of load.

A voltage divider across the supply forward biases the bases so that conduction takes place as soon as switched on. Because of unbalance between the two transistors one starts ahead of

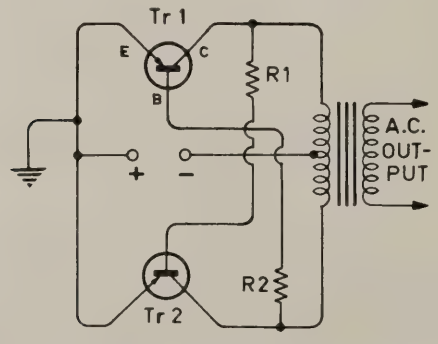


FIG.1 SIMPLE GROUNDED EMITTER CONVERTER

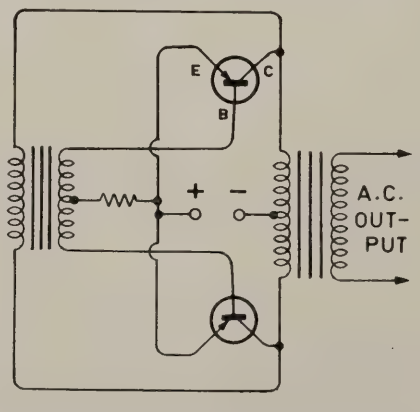


FIG.2 GROUNDED EMITTER CONVERTER WITH TRANSFORMER FOR BASE DRIVE

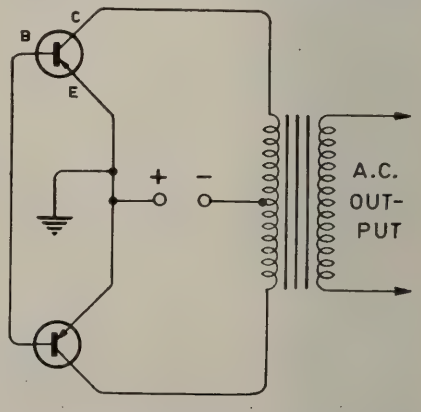


FIG.3 GROUNDED EMITTER CONVERTER WITH TERTIARY WINDING FOR BASE DRIVE

the other and the conditions described earlier take place. R2 is low in value compared to R1 but may dissipate several watts as R1 carries the base drive current for both transistors.

R3 is a limiting resistor as described under figure 2 and its actual value should be chosen to obtain optimum efficiency at rated output. It should also be chosen so as to limit total current.

The Transformer

The transformer is quite within the capabilities of home constructors. The only requirement is a source of mumetal and enamelled winding wire. The latter can usually be obtained from an armature winder or electrical contractor. Mumetal is a little more difficult to obtain but usually most radio parts shops can obtain the small quantity required. Whilst no tests have been carried out it is thought that a slightly larger transformer using Radiometal would work almost as well but perhaps with lower efficiency. Readers well enough versed in transistor circuitry could easily wind a transformer on a Radiometal core (ex a speaker transformer, for example). In many cases readers may have mumetal laminations available from surplus equipment—usually this type of lamination has bright pink or blue paint or varnish on one side as insulation.

The core area should be ¾in. x ¾in. and the winding length of the leg should be 1½in. or slightly longer. E and I laminations should be used. One Standard mumetal lamination used in New Zealand having a centre leg of ¾in. x 1⅛in. has been found to be too short to accommodate all windings. For this reason a 1½in. winding length is recommended.

The windings as per figure 4 are:

From the inside (i.e., first winding)

For 500v and 6v primary—

G-H 900 turns 38 SWG enam.

A-B) 24 + 24 turns 20 SWG

B-C) bifilar wound (see below)

D-F 20 turns 32 SWG

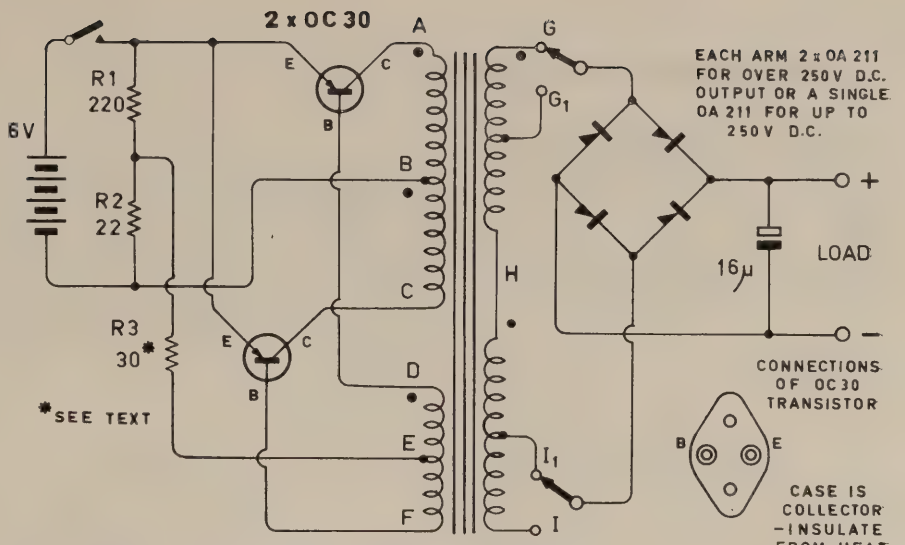


FIG.4 PRACTICAL TRANSISTOR CONVERTER

CT at E

H-I 900 turns 38 SWG

● on figure 4 indicates a start of a winding. Be sure to mark each lead as the winding is being done. The prototype transformer was entirely hand wound and took about two hours to wind up carefully. A quite satisfactory former can be made up out of stiff cardboard or manilla folder and stuck together with "Uhu" glue. Lassovic or Electrical Sellotape should be wound over the finished former and then G-H wound on. Bring all leads out through pin holes in the side of the former. Remember not to put leads where the laminations enfold the former. Each winding should be separated by a layer of insulating tape. When winding the secondary windings G-H and H-I endeavour to ensure that turns of great potential difference are not adjacent; in the extreme G should not cross over H.

The Bifilar winding of A-B and B-C is done by winding the two side by side, i.e., putting on two lots of wire at once. As it is unlikely two reels of 20 G wire will be used one length will need to be cut first. The length of this is best determined by "trial winding" a length of thin string for 24 turns and then using this to measure off a length of 20 G wire.

12 Volt Operation

For 12 volt supply operation it is suggested A-B and B-C be wound each with 50 turns 23 SWG enam wire.

Lower B+ Output

Within the limits of transistor ratings there is no reason why alternative secondary windings should not be used. For instance, the unit described has a two-position switch to provide 90 volts for a triple wave receiver. In this case

G_1 is turn 750 brought out on G-H.

I_1 is turn 150 brought out on H-I.

Very careful winding of the secondary windings could mean that the two could be paralleled for 250v D.C. output. Close balance would be needed to ensure that there were no circulating currents around the two windings (caused by the slightly higher voltage of one winding feeding into the other).

Heat Sinks

The recommended heat sink for an OC 30 in this application is 4in. x 4in. taking into account that entirely free ventilation may not be possible. The sinks, in this case, can be of 16 G aluminium and as the collectors are insulated may be of one piece. Make sure the mica disc and mounting ferrules provided are used to insulate the transistor off the heat sink.

Operation

There should be no difficulty in operation. However, care should be taken to see that the total current drawn from the supply does not exceed 2.5 A unless special cooling provisions are made. R3 should be adjusted to ensure this. Minimum filtering requirements are needed as the frequency of oscillation is about 500 c/s—but will depend upon both the transformer and the load.

(please turn to page 40)

VHF AERIALS

Part I

Transmission Lines

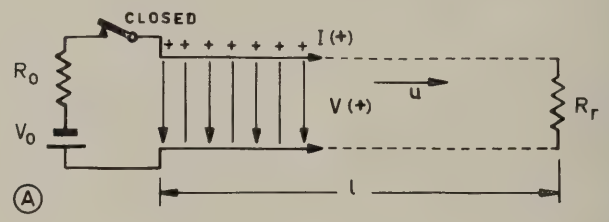
Below is the first section of a summary of the V.H.F. Aerial Course held at the Auckland Technical Institute between the 12th and 20th of August.

The course was arranged by the Auckland Technical Institute and conducted by Messrs. M. A. Jillings, A. Godfrey and R. Cochrane. As well as the lectures, considerable demonstration work was carried out using 100-yard lengths of 50Ω coaxial line to show reflected pulses under varying conditions of matching, and open and shorted terminations. Equipment was also set up to produce standing waves and a 144 Mc Yagi used to demonstrate the change of S.W.R. with change of element spacing, and the change in polar diagram with the change of element spacing and link.

In the classification of radio waves, V.H.F. is given as 30-300 Mc/s (10-1 metres). Within this range of frequencies it is normal to guide the flow of electromagnetic energy from place to place along uniform pairs of conductors which may be electrically balanced with respect to earth (parallel or twisted pair cables) or unbalanced (coaxial or concentric cables). A uniform transmission line is one in which the electrical properties of the line (resistance, inductance, capacitance and conductance per unit length) do not vary throughout its length.

Pulse of Electromagnetic Wave Passing Down a Twin Line

An appreciation of the characteristics of a uniform transmission line can be gained by considering the effect of passing a d.c. pulse down the line. Since the effect of line losses on the characteristics at V.H.F. is small, the line will be treated as loss-free. If such a line were infinitely long, a d.c. pulse would flow down the line without interruption at a finite velocity. The ratio of the potential to which each successive section of the line charges, to the current which flows from section to section as the line charges, will remain constant. The actual value of the ratio of voltage to current will depend upon the physical dimensions of the line. If a section of the line is terminated by a pure resistor of the same value as the ratio (R=V/I), the last section of the line will discharge the energy into the resistor without interruption and the energy will be dissipated by the resistor as heat. The resistance termination replaces a continued infinite length of uniform line. The ratio V/I=Zo, and is called the **Characteristic Impedance** of the line.



Characteristics of a Uniform Loss-free Transmission Line

Line length — l
Characteristic Impedance — Ro
Termination Resistance — Rr
E.M. propagation velocity — U
D.C. generator voltage — Vo
D.C. generator int. resistance — Ro
Notation (+) and (−) refer to waves travelling **from** and **towards** the generator, while s and r refer to **sending** and **receiving** respectively.

1. Termination, Rr = Ro

When Sw is closed, V(+) = Vo/2 appears across the line, and a wave with current flow I(+) = V(+)/Ro = Vo/2Ro travels down the line with velocity U.

When the wave front reaches the receiving end, current Il flows through Rr and voltage Vl appears across Rr.

Since Rr = Ro, the wave energy is completely absorbed by the load, and the line conditions are the same as if the line were part of an infinite length. **No** energy returns to the sending end. Il = I(+), Vl = V(+).

Under these conditions, the generator and line are said to be Matched, since there is maximum transfer of power from the generator to the line, and from the line to the load.

2. Coefficient of Reflection, Rr does not equal Ro

If Rr is greater than Ro, then Il is less than I(+) and Vl is greater than V(+).

This results, since the condition Vl/Il = Rr must be satisfied. Some of the magnetic energy associated with I(+) must revert to electric energy, and the resulting electromagnetic disturbance causes a reflection of energy from the receiving end to the sending end, i.e., a reflected wave results.

Consider that a fraction p of the sending wave is returned:

Then Vl = V(+) + pV(+), and since the ratio of reflected wave voltage to current must equal Ro (line condition),

so that $p = \frac{Rr - Ro}{Ro + Rr}$

p is called the Coefficient of Reflection.

Its magnitude varies from +1 (Rr = infin) through O (when Rr = Ro) to −1 (for Rr = O). When an A.C. generator is considered, p is complex, and this condition will be covered later.

3. Line Characteristics

If C is the total line capacitance,
L is the total line inductance,
and T is the time taken for the E.M. energy to travel from the sending to the receiving end of the line, so that if energy is reflected, the total time from the instant of sending until return is t = 2T, then, for a **Short-circuited Line**

Is = 2I(+), Vs = O, no energy is stored in the electric field, and the energy stored in the magnetic field is:

$\frac{1}{2}L[2I(+)]^2 = 2LI(+)^2$.

and for an **Open-circuited Line**

Vs = 2V(+), Is = O, no energy is stored in the magnetic field, and the energy stored in the electric field is:

$\frac{1}{2}C[2V(+)]^2 = 2CV(+)^2$.

In each case the energy supplied by the generator is V(+)I(+)2T.

So $2V(+)I(+)T = 2LI(+)^2 = 2CV(+)^2$.

For Lossless Lines:

Velocity of Propagation U

U = 1/T Metres/sec.

Characteristic Impedance Ro

Ro = $\sqrt{(L/C)}$ ohms.

Velocity of Propagation

If the electric and magnetic field components of an E.M. wave flowing down a loss-free transmission line exist in free space, the wave velocity is the same as that of an E.M. wave in free-space, i.e., 3 x 10^8 metres per second. Since air differs little in permeability and permittivity from free space, Velocity of Propagation for Air Spaced Transmission Lines is 3 x 10^8 metres per second.

When dielectrics having relative permittivities greater than air are used, the wave travels slower. In particular, for solid dielectrics (solid core screened twisted pairs and coaxial cables):

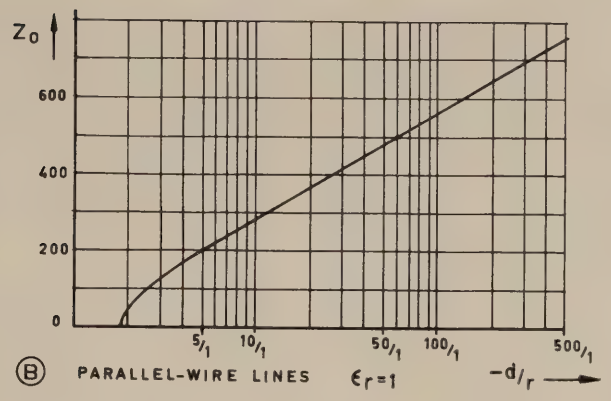
Velocity of Propagation is proportional to $1/\sqrt{Er}$ where Er is the relative permittivity. For polythene, the most popular solid dielectric in present use, Er = 2.3 so Velocity of Propagation is $1/\sqrt{2.3}$ x 3 x 10^8 metres per second.

= **0.66 of free space velocity.**

Characteristic Impedance

The self inductance and self capacitance of a short length of transmission line can be calculated from the physical measurements of the line.

When d is the distance between parallel conductors of radius r, provided that d/r is not less than



4/1, the inductance and capacitance of parallel lines are:

Ll = 0.921 log d/r microhenries per metre,

and Cl = $\frac{12.1Er}{\log d/r}$ picofarads per metre.

$\therefore$

Zo = $\sqrt{(L/C)}$ = [$\sqrt{(92.1 \times 10^4)/12.1 Er}$] log d/r.

= $276/\sqrt{Er}$ log d/r ohms.

Er = rel. permittivity unity for air.

In the case of concentric tube or coaxial lines when r_2 is the outer conductor's inside radius and r_1 is the radius of the inner conductor,

Ll = 0.461 log $\frac{r_2}{r_1}$ microhenries per metre,

and Cl = $\frac{24.1\ Er}{\log \frac{r_2}{r_1}}$ picofarads per metre.

Zo = $\frac{138}{\sqrt{Er}} \log \frac{r_2}{r_1}$ ohms.

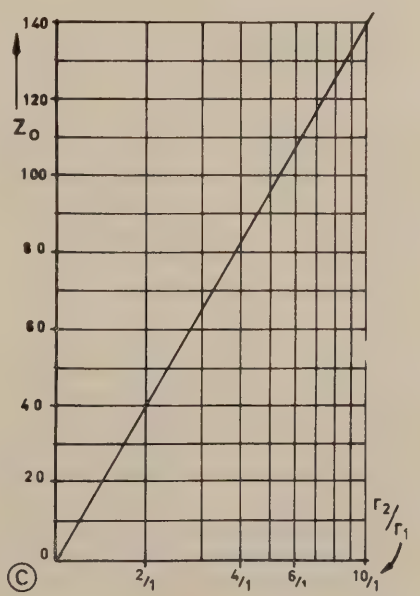
Practical air and semi-air spaced twin feeders usually have impedances from 300 to 600 ohms, while solic dielectric (polythene) enclosed twin feeders have impedances from 75 to 150 ohms and may also be screened.

The impedance of coaxial feeders may range from 15 ohms for solid dielectric types up to 150 ohms for semi-air and air spaced types.

The Reflection of Sinewaves

(Uniform Loss-Free Line)

When sinewaves are sent down a transmission line, the reflected waves which result when there



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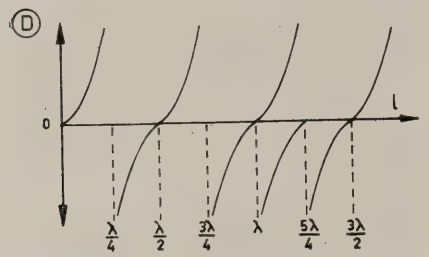
is incorrect termination, will interact with the direct waves. The result is a stationary wave pattern which is called a Standing Wave.

Short-circuited Line

The conditions at the receiving end are Vr = O, p = –1. That is, although the voltage across the end of the line is always zero, it must be considered as consisting of a direct wave component to which is added an equal but opposite reflected component. A quarter wavelength back from the short-circuit, the direct and reflected components add, because they are in phase. (The reflected wave is a half period behind the direct wave at this point, but since it is 180 degrees reversed in phase at the end of the line, it arrives back in phase.)

The point at which the waves add, is called the voltage antinode and the effect repeats at **odd** multiples of quarter wavelengths from the shortest termination.



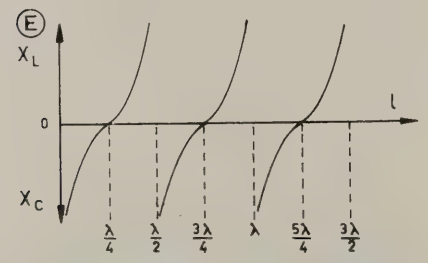
VARIATION OF INPUT REACTANCE OF SHORTED LINE WITH LINE LENGTH.

Voltage Nodes (zeros) occur every half wavelength (or **even** quarter wavelength) from the end of the line.

The current and voltage are in quadrature at every point. (A current maxima occurs at the end of the line, and every half wavelength from the end of the line.)

Open-circuited Lines

The conditions at the receiving end are Vr = 2V(+), p = +1.



VARIATION OF INPUT REACTANCE OF OPEN CIRCUITED LINE WITH LINE LENGTH

The direct and reflected waves add at the end of the line to give a voltage antinode and this condition repeats every half wavelength from the termination.

The current at the end of the line is zero, and the current nodes repeat at the same points as the voltage antinodes.

Other Line Terminations

The direct wave at the receiving end of the line, (V(+))r and the reflected wave (V(–))r are only in phase if the line termination is resistive. Otherwise there is a phase difference between (V(+))r and (V(–))r and p = $\frac{(V(-))r}{(V(+))r}$ has both resistive and reactive components. At points along the line, half wavelength apart, V(+) and V(–) are in antiphase and give Voltage Nodes. At points which are half-way between these nodes, Voltage Antinodes will exist.

At these points, the Impedance is Resistive.

The ratio $\frac{\text{max. peak value}}{\text{min. peak value}}$ of Voltage (or Current) is called the Standing Wave Ratio (V.S.W.R.).

$$S = \frac{V(+) + V(-)}{V(+) - V(-)} = \frac{1 + p}{1 - p}$$

At Voltage Maxima (Antinode)

$$S = \frac{Z_1}{Ro}$$

At Voltage Minima (node)

$$S = \frac{Ro}{Z_2}$$

The input impedance of the line depends on both the line length and the termination.

Quarterwave Transformer

Since $S = \frac{Z_1}{Ro} = \frac{Ro}{Z_2}$

$$Ro = \sqrt{(Z_1 \cdot Z_2)}$$

where Z_1 is the impedance at a voltage maxima, and Z_2 is the impedance at a voltage minima, an odd number of quarter wavelengths from the point at which the impedance is Z_1.

A quarterwave section of line can therefore be used to transform from one impedance to another, provided it has an impedance which is the geometric mean of these impedances.

Halfwave Transformer

Provided a length of line is an exact half or multiple half wavelength long, its output and input impedances will be the same whatever its own impedance—it is equivalent to a 1:1 transformer.

Transmission Line Losses

Decibels of attenuation = $10 \log_{10} (P_1/P_2)$

where P_1 is the power input and P_2 is the power output.

Expressing the power ratio this way avoids the use of negative logarithms—"gain" expressed in –dbs would be calculated from P_2/P_1.

For 1 db loss, power output is approximately 0.8 of power input.

For 2 db loss, power output is approximately 0.8 of 0.8 or 0.6 power input.

For 3 db loss, power output is approximately 0.5 of power input.

For 6 db loss, power output is approximately 0.25 of power input.

For 10 db loss, power output is approximately 0.1 of power input.

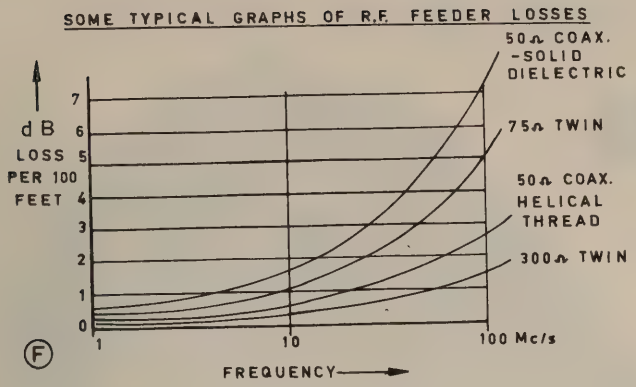
Resistive and dielectric losses both rise with frequency. The former predominate at low, and the latter at high frequencies. In addition, open lines radiate an increasing amount of the energy fed through them at the higher frequencies. Weather also seriously affects many forms of these feeders.

Attenuation is proportional to the square root of the frequency at the lower V.H.F., rising as the dielectric losses become significant.

An examination of the materials, dimensions and construction of various feeders, and a comparison of their attenuation will indicate the steps taken to reduce losses.

Effect of Line Losses

Line attenuation causes both the voltage and current down the line to decrease exponentially as



NEXT MONTH: We will present the second and final section of this course

the load is approached. When the load impedance is equal to the characteristic impedance of the line or matches the line, no energy is reflected and the loss is indicated by the db attenuation for that particular length of line. For example, if a cable has an attenuation of 6 db/100ft. at a certain frequency, then the power delivered to a matched load at the end of a 50ft. length of cable will be 50% of that fed into the sending end.

When a line is mismatched, the reflected energy is again attenuated on its return path, and increased line losses result. Since less energy arrives back at the sending end than that reflected from the receiving end, the V.S.W.R. at the sending end is reduced—a very long line with high attenuation would appear to be "matched" when viewed from the sending end, despite a serious mismatch.

CHOICE OF AERIAL FEEDERS

Transmission

Considerations are: Power Rating which falls with increase in frequency and S.W.R., since losses increase. When the S.W.R. is high relatively low power is sufficient to overheat the conductors at voltage nodes and breakdown the dielectric at the voltage antinodes.

Installation problems — which may necessitate the use of flexible coaxial cables with relatively high attenuation. Open and unshielded semi-air feeders will suffer discontinuities if carried close to surfaces or metal edges, or bent sharply, resulting in radiation and reflections which increase the losses, increase the S.W.R. and may vary the load on the transmitter. The ribbon type feeder varies in impedance when wet, and should not be installed in a manner which allows water to run along its insulation.

Matching methods should always be used to minimise the losses. When either economic or minimum size and weight considerations are paramount, a balanced or coaxial feeder with an impedance which approximates that of the aerial feed point is used. Otherwise, baluns and matching sections which consist of short lengths of transmission line are used at the appropriate ends of the feeder to correctly match the impedances. Adjustments are frequently provided. Further information will be given later, with regard to aerial matching.

Coaxial lines have the major advantage that they do not radiate, but low loss lines are expensive, and installation costs high when high powers are handled. The flexible types are very convenient for low powers. The effect of discontinuities becomes more important at the higher V.H.F. range of frequencies. Spaced discs to insulate coaxial feeders, for example, can seriously affect the impedance if the spacing corresponds to half wavelengths at a particular operating frequency.

Reception

Strong signal pickup and low local noise radiation reduces the need for accurate matching of the aerial to the feeder, but the receiver input should match the feeder if reflections are undesirable as in TV reception. While ribbon type feeder provides an economic feeder, care should be taken to prevent discontinuity such as water being held on the ribbon during wet weather, or erratic reception can result.

When strong local noise exists, transposing a ribbon type balanced line by twisting it may be insufficient to reduce the noise, and a shielded type line could be more desirable. When the line is carried through buildings or the metal linings of mobile vehicles, flexible coaxial cable is usually much easier to instal and more reliable.

When very weak signals are to be received a good match at both the aerial and receiver becomes necessary. Since some local noise is usually present and losses due to discontinuity and change of impedance in wet weather results when ribbon type feeder is used, low loss coaxial (semi-air flexible types) is desirable, but increases the installation costs.

Matching sections are not necessary for TV aerials when strong signals are being received provided the tuner input is reasonably well matched to the line. However, if the aerial is matched, a poorly matched tuner will not cause reflection ghosts in the receiver, since the energy returned to the aerial is re-radiated and not reflected. Since it is not uncommon for change in impedance to take place in a tuner over its range of frequency coverage, when strong signal is present, a desirable termination between the feeder and tuner is a resistive attenuator.

ENQUIRY CARD AD. 15

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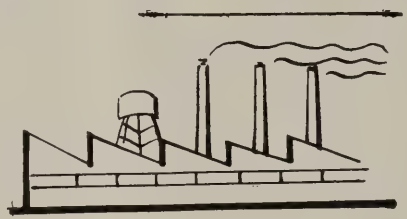

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AWA TV RECEIVER

35 Series

Models ZL52, ZC52, DZ52, FC52, SC52

COMPONENT REPLACEMENTS

L101	Sound I.F. Coil	K43336
L201-2	Video I.F. Input & Trap Coil	K51664
L203	I.F. Filter Choke	K40323
L204	I.F. Filter Choke	K49671
L205	Vision Peaking Coil	K40117
L206	5.5 Mc/s Trap Coil	K43593
L207	Vision Peaking Coil	EW7403
L401	Sine Wave Coil	K40050
L402	Coil, 1.5μH	K214516
L403	Horizontal Linearity Coil	K43264
L404-7	Deflection Coil Ass'y (Console Models)	EA7434
L404-7	Deflection Coil Ass'y (Lowboy Models)	EA7432
L408	H.T. Filter Choke	K40113FZ
T101	Ratio Detector Transformer	K40077
T102	Sound Output Transformer	EA7318
T201	1st Video I.F. Transformer	K42867
T202	2nd Video I.F. Transformer	K42869
T203	3rd Video I.F. Transformer	DW7402
T301	Vertical Blocking Oscillator Trans.	DA7312
T302	Vertical Output Transformer	K43340A
T401	Horizontal Blocking Oscillator (Horizontal Hold)	K41579
T402	Horizontal Output Transformer	CA7454
T404	Mains Transformer	CA7307
VR101	Tone 500K ohm Rev. Log Carbon W/S	DP5652
VR102	Volume 500K ohm Log. Carbon	DP5651
VR201	Contrast 500K Lin. Carbon	DP5653
VR301	I.F. A.G.C. 200K ohm Lin. Carbon	DP6726
VR302	Min. Contrast 20K hm Lin. Carbon	DP6727
VR304	Vert. Hold IM ohm Lin. Carbon	DP6730
VR305	Vert. Lin. 100K ohm Lin. Carbon	DP6728
VR306	Top Lin. IM ohm Lin. Carbon	DP6729
VR307	Height IM hm Lin. Carbon	DP6729
VR308	Brightness 500K ohm Lin. Carbon	DP5653
VR401	Width IM ohm Lin. Carbon	DP6729
C116	50μFd, 10μFd Electrolytic	XP2488
C326	50μFd, 10μFd Electrolytic	XP2488
C426	100μFd, 200w.v. Electrolytic	K229711
C427	100μFd, 200w.v. Electrolytic	K229711
C428	100μFd, 400w.v. Electrolytic	XP10006
FS401-2	Fuse, 1.5 Amp.	K370023
LS101	8" Speaker	XA3733
LS102	4" Speaker	XA3734
LS101	5" x 3" Speaker (Lowboy Models)	XA3744

Tuning Strips, Turret Tuner (AWA)

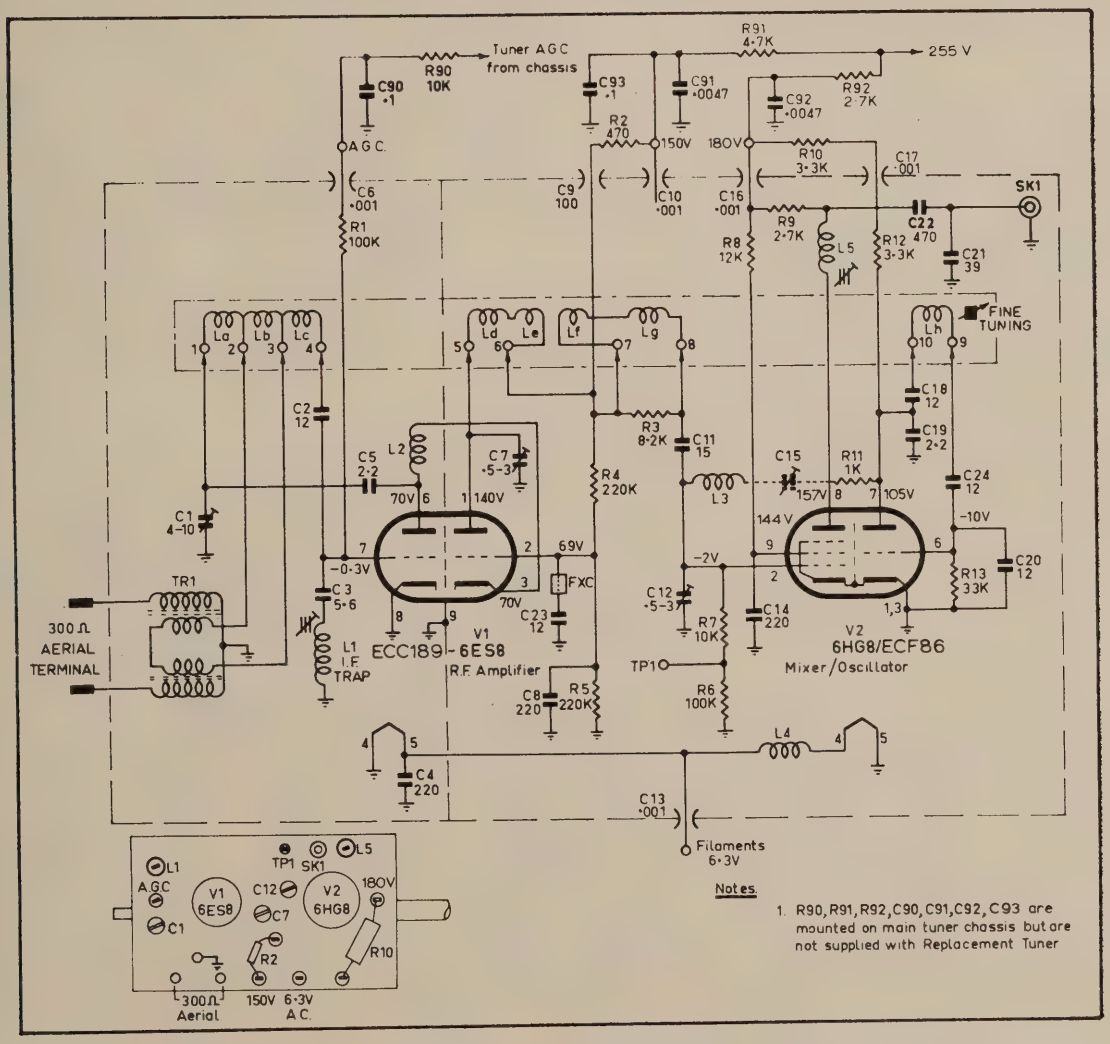
Channel 1	K44470
Channel 2	K44471
⋮	⋮
Channel 9	K44478
Tuner, Complete (A.W.A.)	K44099

Tuning Strips, Turret Tuner (AB Metal)

Channel 1	XP8072/1
Channel 2	XP8072/2
⋮	⋮
Channel 9	XP8072/9
Tuner Complete (AB Metal)	CA7209

Readers are referred to our September 1963 issue for the circuit of the A.B. Metal Tuner.

A.W.A. TYPE TI0 TURRET TUNER (DZ52, ZL52)



Notes.

1. R90, R91, R92, C90, C91, C92, C93 are mounted on main tuner chassis but are not supplied with Replacement Tuner

SERVICE ADJUSTMENTS

Horizontal Oscillator Adjustment

This adjustment is made at the factory and should not require re-adjustment in the field. However the adjustment should be carried out whenever components in the horizontal oscillator circuit are changed. The width should be correctly set before adjustments are carried out.

NOTE:

Under normal circumstances, unless C408 or L401 are replaced, no sine wave coil adjustment will be required, and the correct horizontal oscillator conditions will be obtained by following steps 2, 3 and 5 below.

1. Short circuit the "Sine Wave" stabilizing coil L402.
2. Short circuit pin 2 of V402 (phase discriminator test point) to earth.
3. Adjust the horizontal hold control until the sides of the picture are vertical.
4. Remove the short circuit from the "Sine Wave" stabilizing coil and adjust the iron core of this coil until the sides of the picture are again vertical.
5. Remove the short circuit from pin 2 of V402.

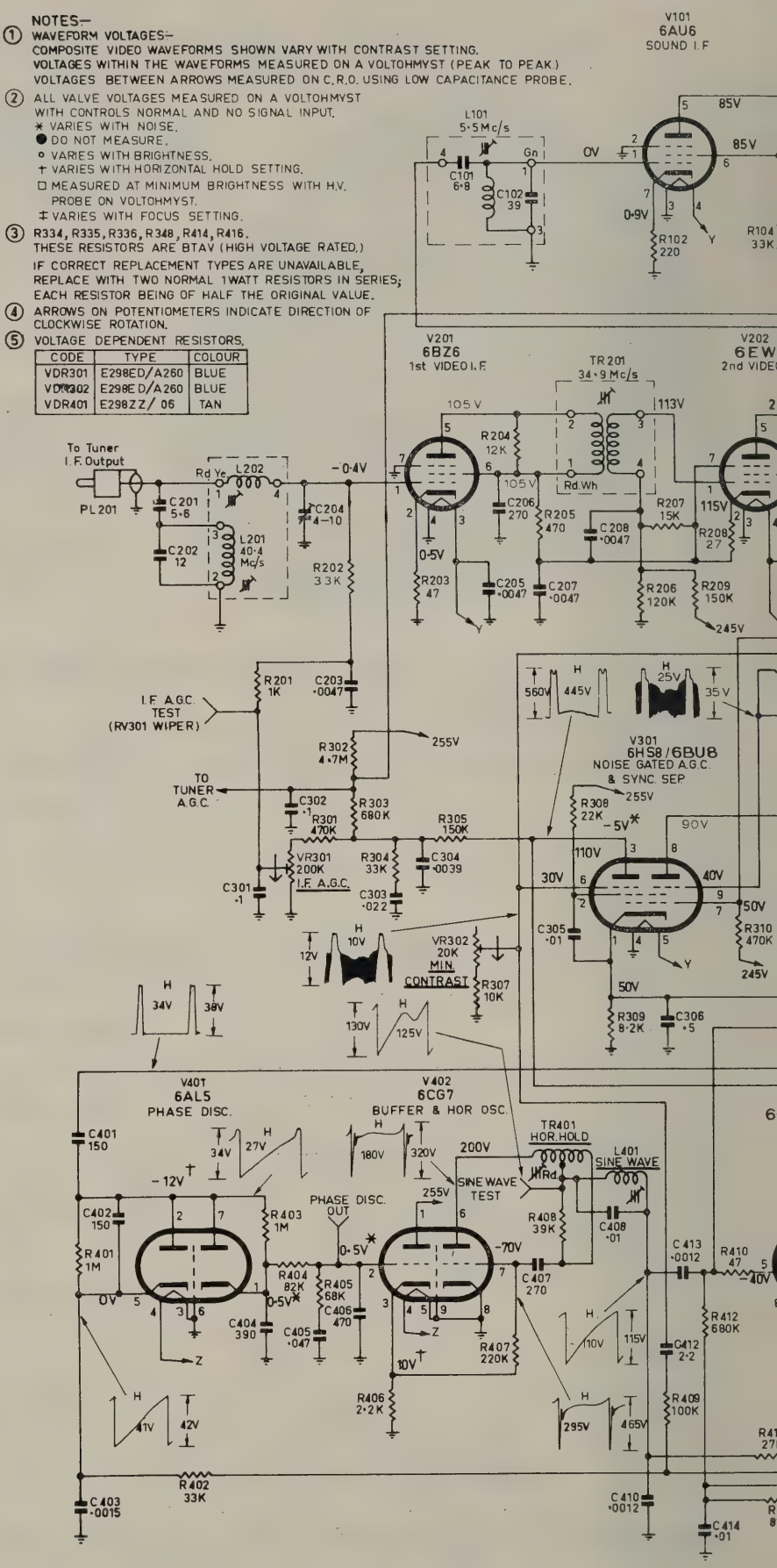
Focus Adjustment

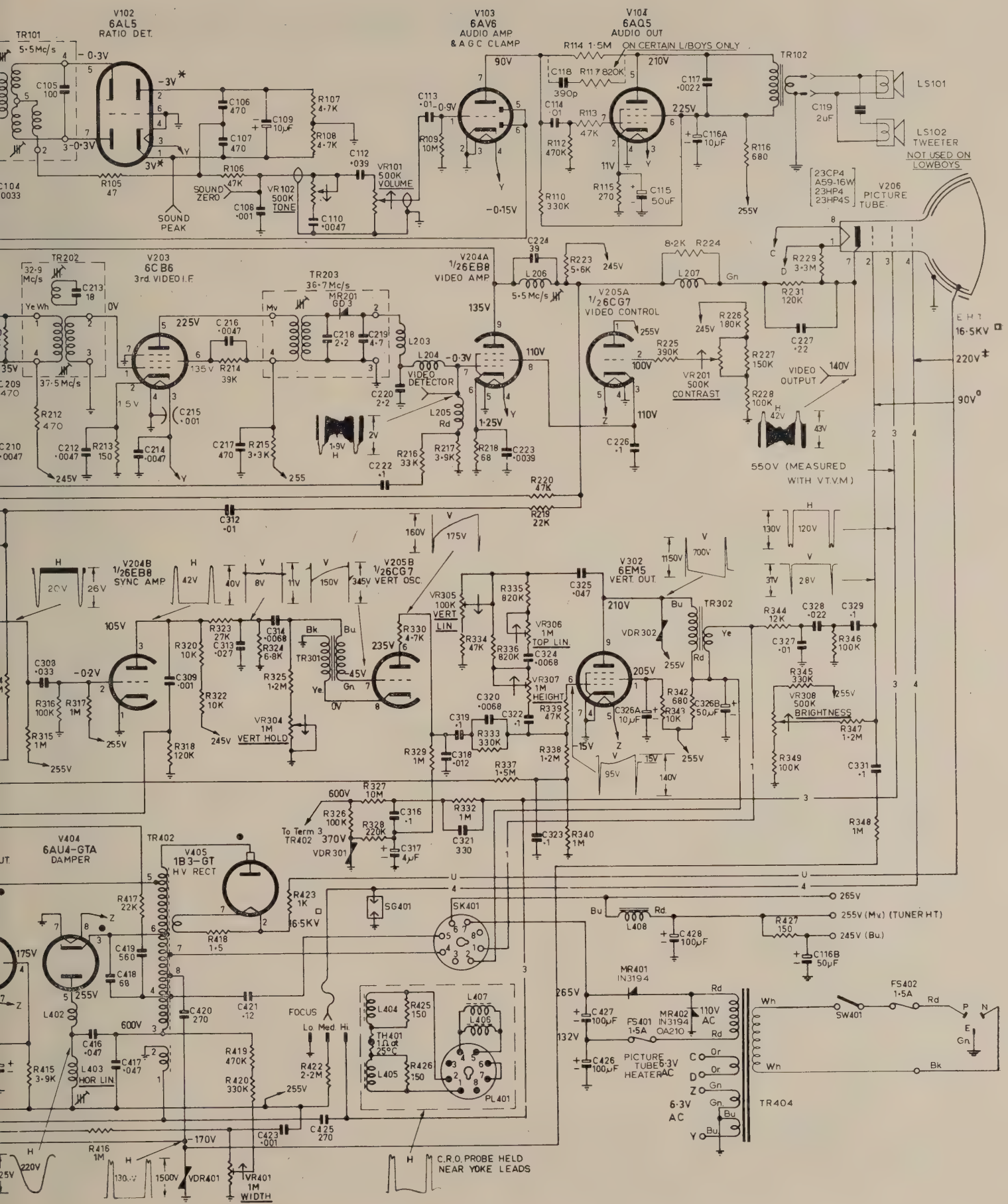
This is a factory adjustment and should not need resetting unless the Picture tube is replaced.
The wander lead is attached in turn to the three taps provided, and then left on the tap giving best focus in the centre area of the raster at normal contrast and brightness.

A.G.C. Adjustment

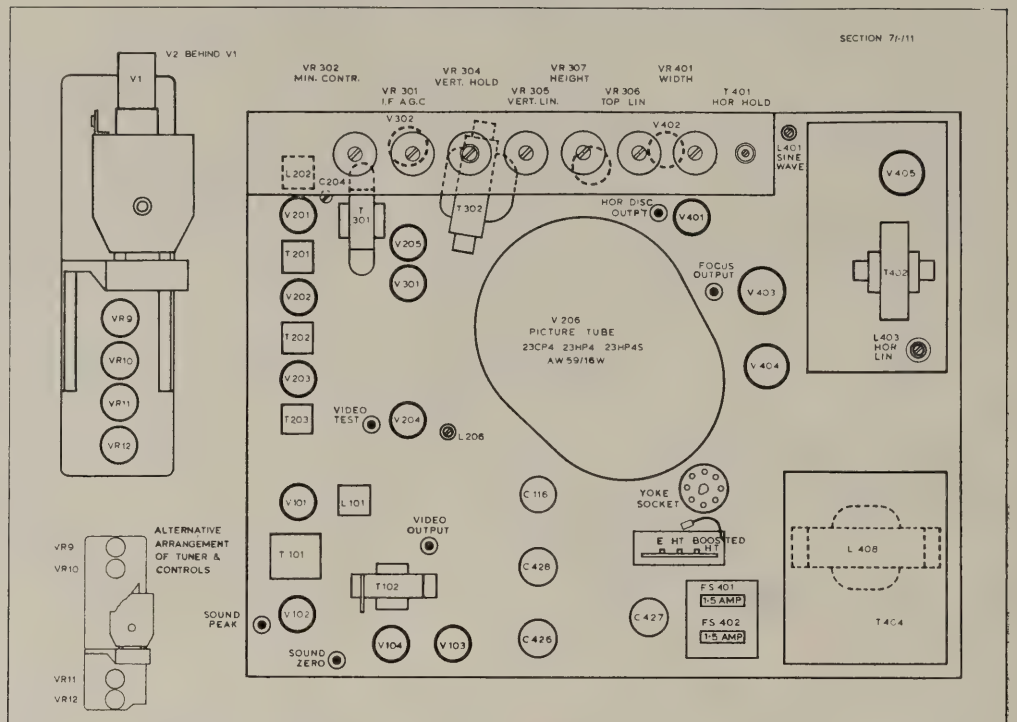
This adjustment to be made only after all other adjustments have been checked.

1. Set the minimum contrast and I.F. A.G.C. controls at their mid positions.
2. Apply a reasonable signal (no less than that in which background receiver noise is just discernable) fully modulated as per N.Z.B.C. standards to the receiver.
3. Set the contrast control to minimum (fully anti-clockwise).
4. Adjust the minimum contrast to give .75 p-p at the video detector test point. (Measure with low capacitance probe and oscilloscope adjusted for D.C. input .1v range).
5. Adjust main contrast control to give .1v p-p at detector and adjust I.F. A.G.C. control for noise threshold visibility, then back off a few degrees. A clockwise rotation of the "I.F. A.G.C." control increases snow.
6. Repeat above steps to obtain .75 p-p at minimum contrast if necessary.




V102 6AL5 RATIO DET.
V103 6AV6 AUDIO AMP & A G C CLAMP
V104 6AQ5 AUDIO OUT
R114 1·5M ON CERTAIN L/BOYS ONLY
TR101 5·5Mc/s
TR102
LS101
LS102 TWEETER
NOT USED ON LOWBOYS
VR101 500K VOLUME
VR102 500K TONE
SOUND ZERO
SOUND PEAK
V206 PICTURE TUBE
23CP4 A59-16W 23HP4 23HP4S
TR202 32·9 Mc/s
V203 6C B6 3rd. VIDEO I.F.
TR203 36·7Mc/s
MR201 GD3
V204A 1/26EB8 VIDEO AMP
V205A 1/26CG7 VIDEO CONTROL
VIDEO DETECTOR
VR201 500K CONTRAST
VIDEO OUTPUT
37·5Mc/s
5·5Mc/s
E.H.T. 16·5KV
220V
90V
550V (MEASURED WITH V.T.V.M.)
V204B 1/26EB8 SYNC AMP
V205B 1/26CG7 VERT OSC.
V302 6EM5 VERT. OUT
TR301
TR302
VR304 1M VERT HOLD
VR305 100K VERT LIN
VR306 1M TOP LIN
VR307 1M HEIGHT
VR308 500K BRIGHTNESS
V404 6AU4-GTA DAMPER
V405 1B3-GT H.V. RECT
TR402
SG401
SK401
L402
L403 HOR LIN
L404
L405
L406
L407
PL401
TH401 1Ω at 25°C
FOCUS Lo Med Hi
VDR301
VDR302
VDR401
VR401 1M WIDTH
MR401 IN3194
MR402 IN3194 OA210
FS401 1·5A
FS402 1·5A
SW401
TR404
PICTURE TUBE HEATER 6·3V AC
C.R.O. PROBE HELD NEAR YOKE LEADS
To Term 3 TR402
265V
255V (Mv) (TUNER H.T.)
245V (Bu.)
110V AC

CHASSIS LAYOUT & VALVE FUNCTIONS



V1	6ES8/ECC189	R.F. AMPLIFIER IN TUNER
V2	6HG8/ECF86	R.F. OSCILLATOR & CONVERTER
V 101	6AU6	1ST SOUND I.F.
V 102	6AL5	RATIO DETECTOR
V 103	6AV6	AUDIO AMPLIFIER
V 104	6AQ5	AUDIO OUTPUT
V 201	6BZ6	1ST VIDEO I.F.
V 202	6EW6	2ND VIDEO I.F.
V 203	6CB6	3RD VIDEO I.F.
V 204	6EB8	VIDEO OUTPUT & SYNC. AMP.
V 205	6CG7	VIDEO CONTROL & VERT. OSC.
V 206	23CP4/23HP4/23HP4S OR AW 59/16W	PICTURE TUBE
V 301	6HS8/6BU8	NOISE GATED A.G.C. & SYNC. SEP.
V 302	6EM5	VERTICAL OUTPUT
V 401	6AL5	PHASE DISCRIMINATOR
V 402	6CG7	BUFFER & HORIZONTAL OSC.
V 403	6CM5	HORIZONTAL OUTPUT
V 404	6AU4-GTA	EFFICIENCY DIODE
V 405	1B3-GT	HIGH VOLTAGE RECTIFIER
MR 201	OA160/OA70	VIDEO DETECTOR
MR 401, MR 402	1N3194	SILICON DIODE RECTIFIERS
FS 401, FS 402		1·5 AMP FUSES

D.C. RESISTANCE OF WINDINGS

WINDINGS		D.C. RESISTANCE OHMS
Tuner Windings		*
L101	Sound I.F.	*
L201-2	Video I.F. Input & Trap	*
L203	I.F. Filter Choke	4
L204	I.F. Filter Choke	*
L205	Vision Peaking Coil	6
L206	5.5 Mc/s Trap Coil	1.5
L207	Vision Peaking Coil	5
L401	Sine Wave Coil	55
L402	Coil, 1.5μH	*
L403	Horizontal Linearity Coil	6.3
L404	Deflection Coil	2.5
L405	,, ,,	2.5
L406	,, ,,	17
L407	,, ,,	17
L408	H.T. Filter Choke	40
T101	Ratio Detector	
	Primary 1-6	9.5
	Secondary 3-4	1
T102	Sound Output	
	Primary	397
	Secondary	*
T201	1st Video I.F. Transformer	*
T202	2nd Video I.F. Transformer	*
T203	3rd Video I.F. Transformer	*
	Primary Blue-Green	525
	Secondary Red-Yellow	163
T302	Vertical Output Transformer	
	Primary Blue-Red	350
	Secondary Red-Yellow	2.5
T401	Horizontal Blocking Oscillator	
	Yellow — Anode	24
	Yellow — C407	88
T402	Horizontal Output	
	1-2	1.52
	3-4	3.3
	3-8	7.0
	3-7	10.1
	3-6	18.3
	3-5	23.3
	5-Anode	415
T404	Mains Transformer	
	Primary White-White	7
	H.T. Sec. Red-Red	4.3
	Heater Secondaries	*

* Less than 1 ohm.

The above readings were taken on a standard chassis at 20°C. but different materials used in manufacture may cause variations, and it should not be assumed that a component is necessarily faulty if a slightly different value of resistance is measured.

SERVICEMAN'S COLUMN

Conducted by J. Whitley Stokes

At the risk of boring those readers whose work or interests do not include TV, I am again devoting some space to this subject. As time goes by it is obvious that independent servicemen are going to get more and more requests for TV service. Daily I am coming across owners of TV receivers who have in most cases had compulsory service contracts during the period the set was on hire-purchase and who are now faced with the problem of whether to continue with the arrangement. Alternatively they may have elected to take an optional service contract when purchasing for cash. In both cases the experience is often the same, perhaps one or two calls for minor adjustments in the first year and perhaps no calls at all during the second year. In such cases the owner may well wonder if say £25 in two years is a rather dear form of "insurance", and decide to take the risk of a new picture tube being required and pay for his TV service as the need arises. Only today I had a call to repair a three-year old set that had never been touched since being installed—yes, such sets do exist!

This brings to the fore another aspect of servicing which is only now starting to make itself felt in the Auckland area where TV has been longest established. This is, that just as in the parallel case of radio, the initial servicing is usually a matter of repairing one particular fault at one time, but now that TV sets are getting older the serviceman is apt to find that there may often be several separate faults in one set. The owner's complaint may go something like this: "The telly just went off suddenly last night but before that we used to notice dark lines across the screen sometimes and sometimes there used to be a buzzing noise."

After rectifying the particular fault that caused the family to be bereft of entertainment the previous evening, the serviceman is then faced with the problem of sorting out the other complaints and trying to decide whether they could have any bearing on the fault that caused the receiver to become inoperative.

1. "Dark lines across the screen"—could be sound bars due to mistuning or could be sound bars due to tuner drift which made it impossible to correctly adjust the fine tuning control. At least this fault should be readily apparent, but on the other hand the owner's description may be misleading and there may be some quite different cause for the complaint.

2 "Buzzing noise"—could be lots of things, drift in quad. coil (if it uses one), incorrect AGC setting, IF alignment slightly off, could even be an open or low capacity filter condenser as the customer usually can't distinguish between buzz and hum anyhow.

However, enough of details. The point emphasised is that whereas earlier in the life of a TV set, a service call was often nothing more than a matter of replacing a faulty valve or instructing the user how to adjust the frame hold control, as these same sets get older we are going to get more and more cases of the owner putting up with minor annoyances until such time as a complete breakdown of sound or vision (or both) occurs. It is in such cases that servicemen, if they are endeavouring to provide complete customer satisfaction, will bear in mind the likelihood of further minor faults once the cause of the complete breakdown has been discovered and attended to.

Unfortunately the minor faults can often be the most time-consuming ones to locate particularly if they happen to be (Heaven forbid!) of an intermittent nature, but it is in the serviceman's own interest to be on the lookout for such defects.

Still on the same subject of TV the following observations are offered for what they are worth. Recently in the course of repairing a receiver which had a defective tuner, the thought occurred: "Was it really necessary to trade-in the tuner or could the fault be repaired instead?" In the past it has been my policy to regard tuner repairs as best left to the manufacturer's service department or factory. Indeed, most servicemen are glad to avail themselves of the manufacturer's trade-in service when it is provided.

At the same time I have wondered whether this policy should always be rigidly adhered to—for myself I am a great believer in judging every case on its merits. After having repaired a few tuners I have come to the conclusion that some repairs at least are not beyond the capabilities of the average serviceman. On the other hand I can well understand the manager of a service company issuing instructions that no tuner repairs, other than valve replacement, are to be attempted. Certainly a complete replacement of a faulty tuner is usually much quicker and thus saves the serviceman's time and may, under some circumstances, be cheaper in the long run. On the "for" side, perhaps a brief description of a recent repair job might be in order.

The set in question exhibited the following symptoms—no picture, sound weak and distorted accompanied by heavy buzz, raster normal. A signal from the sweep and marker generator could be injected at the input to the IF strip and gave a normal response curve on the scope, but nothing could be obtained when connection was made to the tuner test point. This particular tuner was of the rather small size incremental type employing a P.C. board on which everything except the switch was mounted. However, it was possible by removing the bottom cover to get access to the printed side of the board (but not the components)

(please turn to page 33)

A Versatile Regulated Power Supply

by M. Lister

This power supply will prove to be a useful piece of equipment for anyone engaged in development or experimental work utilising valves. Also, it will be useful for production testing of amplifiers or similar equipment. By means of the respective controls, the output voltage may be set to any value from zero to +600V and will remain at this voltage. Whilst the load varies from zero to 300 mA on the mains input voltage varies up and down within reasonable limits.

Components used for the construction of this unit are readily available and the cost is very modest. It is surprising how few people possess or utilise regulated power supplies when their advantages are balanced against their cost.

Before describing the circuit, a few notes on the essential requirements of a regulated power supply will assist in the understanding of its operation.

Figure 1 is a block diagram showing the basic circuit for this instrument.

The series control tube operates as a variable resistor whose value is controlled by the output of a high gain amplifier A. The output of this amplifier is proportional to the difference between the regulated output voltage and the reference voltage. Any changes in output voltage from the regulator alter this difference voltage and consequently the output of A, which changes the effective series resistance of the control tube, in such a direction, as to restore the regulated output voltage to its original value.

1. The Unregulated Power Supply:

This power supply must have an output voltage which does not fall below the sum of the maximum required regulated output voltage plus the minimum series regulator voltage drop at maximum current load. Both must be considered to occur at minimum mains supply voltage.

Very simple capacitor input filtering may be employed but the ripple must not reduce output voltage below limits laid down above.

As the output voltage required is around 670v on load, two capacitors in series were necessary for the output reservoir capacity. A full wave voltage doubler rectifier system was chosen to keep cost at a minimum.

2. Series Control Tube:

Here a TV line output power tube was chosen on the grounds of good performance and cost. The power dissipation in this section will be equal to the difference of the input and output voltages multiplied by the load current. Three tubes each having a maximum of 20 watts anode dissipation would allow a drop of 200v at 300 mA load current. For this reason the unregulated supply voltage is adjusted by a tap switch so that its output does not exceed the regulated output by more than 200v at full load current.

By using a high current beam tetrode for the regulator tube, the minimum cathode to anode voltage may be as low as 30v at full load current while a small auxiliary supply maintains the screen at +120V.

3. The Amplifier A:

As this amplifier must produce an output voltage swing of 30 or more volts for an input variation of a fraction of a volt its gain must be very high. Thus the higher the gain in this section the smaller will be the regulator output voltage variation with change in load. For this reason, positive voltage feedback is employed and the amplifier is direct coupled and capable of withstanding the maximum operating voltage of the regulator section. To avoid any likelihood of parasitic oscillations, grid and screen stoppers are utilised in this amplifier.

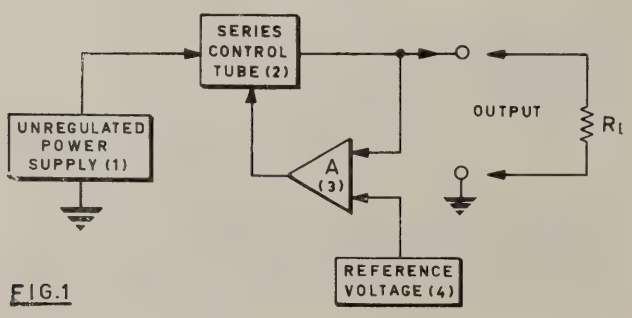


FIG.1

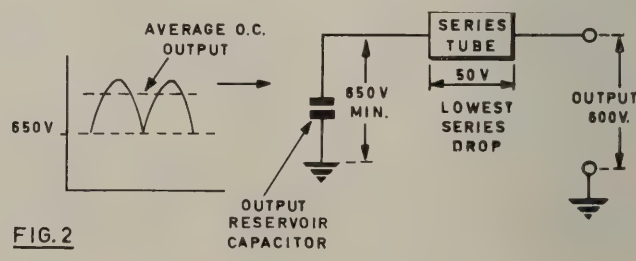


FIG.2

4. Reference Voltage Section:

If the output voltage of the regulator is to stay within close limits, then the reference voltage must have a considerably higher order of stability. A one per cent variation of reference voltage will alter the output of the regulator by a similar amount. Unfortunately, V.R. tubes and Zener diodes are sentitive to variations of current flowing through them and therefore it is desirable to regulate this supply current for the reference to establish the best operating conditions for this section of the equipment.

Description of Regulator Operation:

(See Figure 3).

V1 is a direct coupled high gain amplifier, V2 provides by cathode follower action a low impedance positive bias which is required at V1, cathode. (The control grid of V1 is positive with respect to A by approximately 20v so the cathode of V1 must be about 22 volts positive to correctly bias V1).

R1 and R2 form a voltage divider which holds V2 grid near the potential required at the common cathodes of V1 and V2.

The anode load R5 of V1 is returned to the screen of V3, instead of the cathode, so reducing the voltage variations across it, and hence V1 anode current swing required during regulator operation. This effectively increases gain of V1 by a value of at least four times.

The grid voltage of V1 is equal to the regulated output voltage minus the drop across the reference tube 85A2.

When the supply is first switched on, the 85A2 is not conducting and because V1 cathode is about +20v above A while the grid is returned through R4 to point A, V1 is cut off. This drives V3 grid positive until V3 conducts raising the voltage at the output until the 85A2 tube strikes. The output voltage will continue to rise, raising the voltage at V1 control grid until V1 conducts. Then V1 anode voltage will fall, tending to cut off V3 and preventing any further increase of output voltage.

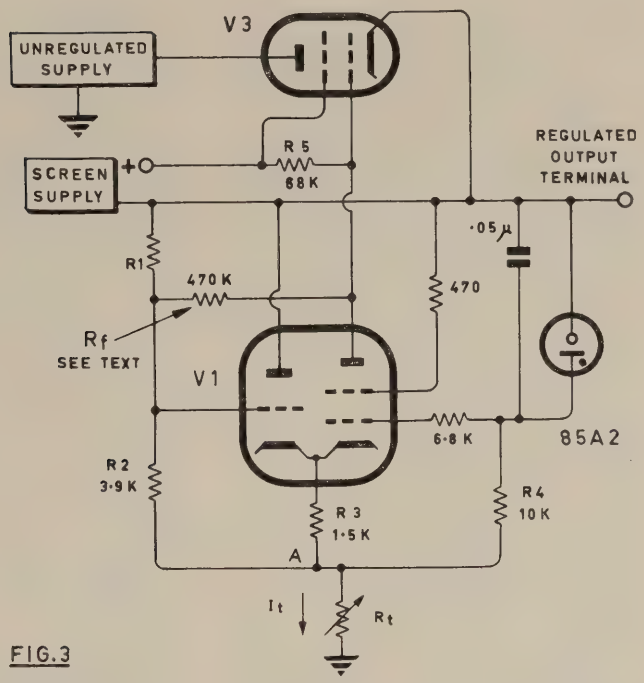


FIG.3

As V1 cathode current varies, so will the potential of the cathodes change slightly reducing the effective gain of V1. By adding the resistor Rf between V1 anode and V2 grid, a small correction voltage is introduced which can be adjusted to reduce the common cathode voltage variation to zero. This is equivalent to positive feedback, raising the gain of our error amplifier. By adjusting the value of Rf, whilst varying the load on the regulator (or the mains supply voltage) output voltage variations may be reduced to a minimum.

As Rf is adjusted for constant output voltage, the voltage across R1 + R2 is constant and so therefore is the current through them, and since the voltage across R3 is also constant, the current through it will also be so. Since the output voltage is constant, the voltage across R4 (this equals the output voltage minus that dropped across the 85A2) must also be constant and current through it will not vary. This current is that supplying the 85A2 and this satisfies our earlier requirement.

These three constant currents flow to point A and a resistance of any value Rt may be placed between A and earth. The point A will rise in voltage by Rt + It, and as the voltage from A to regulator output terminal is constant, the regulator output voltage will rise by the same amount. By this means, the output of the regulator may be raised from +105v to +650v. The ratings of the ECF86 are not exceeded even for the triode section (Va max = 125v) because even at full output voltage, the voltage between output terminal and point A is only 105v.

To reduce the output to zero point A must be returned to a point –105v with respect to the E terminal, and by means of Rt raised from this to + 200v output. Output on this zero –200v range is not so well regulated due to the current variations through the OB2 creating small differences in the voltage drop across this regulator tube.

Fig. 4 shows the circuit of the complete regulator. A single transformer supplies all sections of the equipment and two extra windings of 6.3v at 6A each for external use.

The main voltage doubler winding is tapped so that the unregulated output voltage can always be some 200v above the regulated output.

The maximum load on the –150v line must not exceed 5mA when using Range 1 but can be increased up to 25 mA for the other ranges. Greater loads than this may cause variations of both

output lines particularly on Range 1.

If low cost is the main objective and outputs below + 105v are not required, the regulated negative supply may be dispensed with entirely. Also, two of the EL500's may be omitted with no other circuitry alterations, but the maximum load should not exceed 100mA for each EL500 in circuit. All resistors should be 1W high stability cracked carbon types of 5% tolerance except where noted for wire wound types or where * (an asterisk) indicates that ½ watt composition resistors may be used.

The 6.8 nanofarad condenser increases the regulator amplifier gain for A.C. and reduces the output ripple to a satisfying low figure. The 680 pf condenser from the ECF86 pentode section anode to ground is required to prevent oscillation at some parts of the output range. It should be at least 1000v rating mica type. As the output may be set within 2% by means of the regulator controls a voltmeter was considered unnecessary but an output load current meter with silicon diode protection against drastic overloads, is a useful addition. The meter movement should have a full-scale voltage drop of 250mV and some extra R may have to be added to bring this up if a meter with a different value is used. A 1mA movement with a total of 250 ohms would be a normal choice. The shunts may be made with constantin (enamelled) wire for full-scale currents for the user's choice.

If the meter has greater than 250mV full scale drop then errors will be introduced by addition of the silicon diode which may be a cheap 200 P.I.V. type 450mA rating.

The control potentiometer used was a 10K. 5w. "Reliance" type. To check on the output stability a portion of the regulator's output is compared against a 12V lead acid battery as in Figure 5. The null meter should have a full-scale deflection for 250mV or less and would with advantage be a stable V.T.V.M. type to withstand possible overloads. A 50 uA movement with 1000 ohm internal resistance (50mV full scale deflection) is very satisfactory, however. The 390K ohm resistor in series was used to protect the meter against large out of balance conditions while preliminary setting up was carried out.

With the mains set at 230v input (Standard for N.Z. ! ! !) and the supply unloaded a value of R should be selected so that with the output voltage at which measurements are to be made, the slider will be near the top of resistance element as shown in Fig. 5. This gives smoothest adjustment of balance. The potentiometer is now set precisely at balance with the sensitivity switch closed, then the load is applied. The meter will now read the approximate change of output at 12v, i.e., 10mV on meter would be equivalent to 100 mV at 120v or 200 mV at 240v output from regulator. (A correction may be made if required for error introduced by the null meter away from balance). The value of Rf

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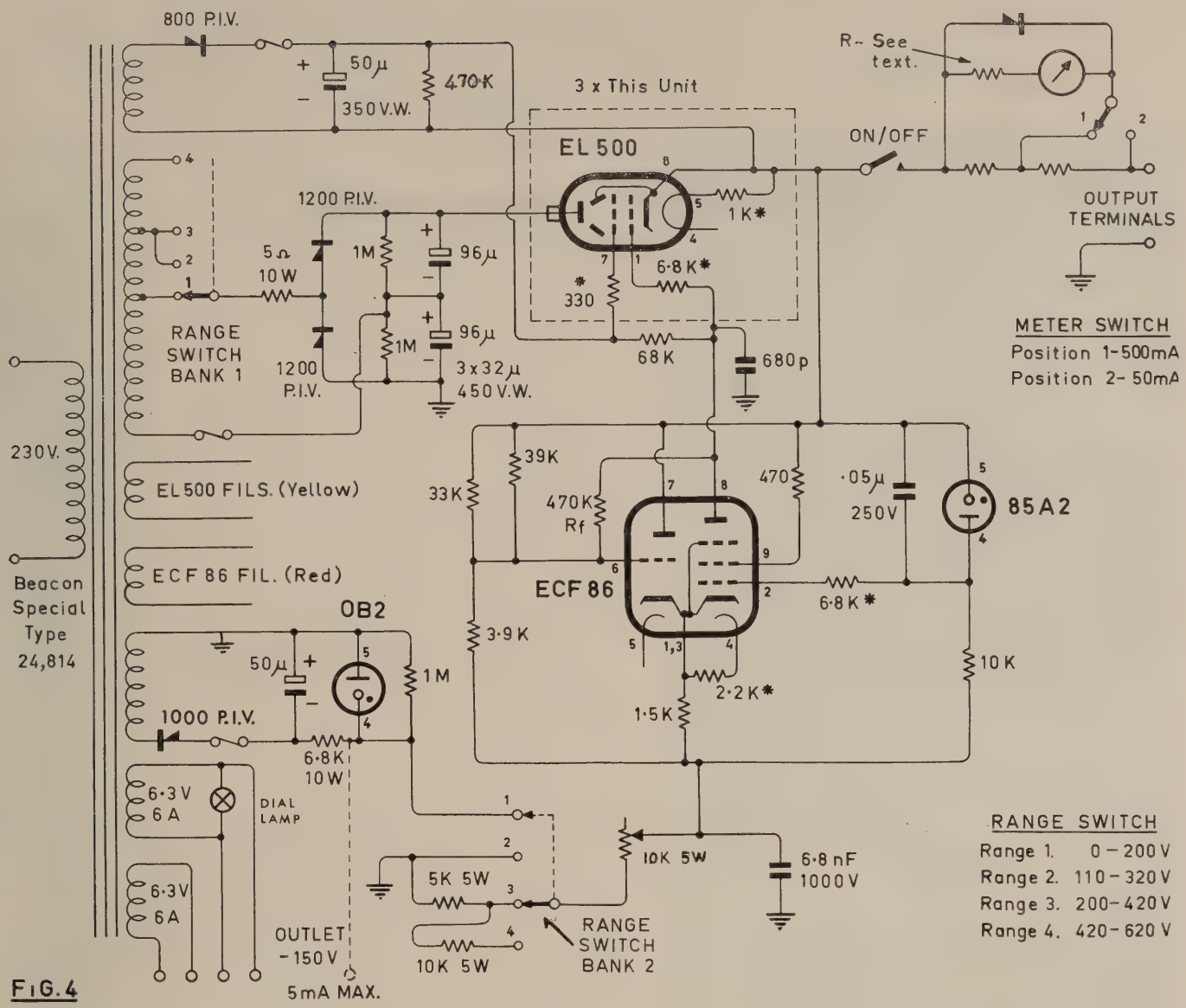

FIG.4

should be adjusted for the lowest output variation against variations of load current and mains voltage. The writer used a V.T.V.M. 250 mV full-scale meter for the null indicator, thus simplifying the interpretation of out of balance meter indications. **Note:** R should be a cracked carbon or wire wound type of stable value.

At 300v output the output voltage dropped 300 mV for a load of 250 mA indicating roughly the performance to be expected from this supply.

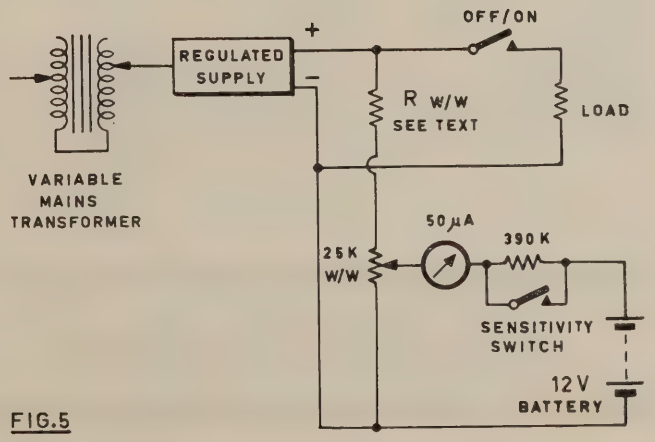

FIG.5

ENQUIRY CARD 12

Advance timer counters

TC2

1Mc/s Timer Counter

Display Four edge-lit in-line indicators with $\frac{3}{4} \times \frac{3}{8}$in numerals with decimal points. *Accuracy* ± one count ± accuracy of standard. *Display resetting* Automatic, manual or by positive pulses. *Frequency measurement* Range 0 to at least 1Mc/s. *Gate times* 0·001, 0·01, 0·1, 1 and 10s. Decimal point automatically positioned for display in kc/s. *Sensitivity* Normal input 10c/s to 1Mc/s. Sinusoidal signal between 200mV and 250V r.m.s. Non-sinusoidal signal not greater than 400V pk. V.L.F. input 0 to 10kc/s. Signals between +2 and +50V pk. *Input impedance* Normal input 100kΩ shunted by 30pF. V.L.F. input 5kΩ approx. *Time measurement* 3μs to 10^5s. *Period measurement* From 1 to 10^5 periods. *Counting* 1 to 9999 regular or random pulses. *Frequency standard* INTERNAL 1Mc/s crystal oscillator, oven controlled at 65°C. Accuracy 1 part in 10^6 at 25°C ambient. ±5 parts in 10^6 from 0 to 35°C. EXTERNAL Any sinusoidal signal between 1kc/s and 1Mc/s of amplitude between 1 and 10V r.m.s. or suitable pulse signal. External gate control available. *Check* Self-checking facilities incorporated. *Operating temperature range* 0 to 35°C ambient. *Power requirements* 100 to 125V or 200 to 250V, 45 to 100c/s, 35W. *Dimensions* $8\frac{1}{2}$in (22cm) wide × 6in (15cm) high × $7\frac{1}{2}$in (19cm) deep. *Weight* $12\frac{1}{2}$lb (5·7kg).

TC10

10Mc/s Transistorised Timer Counter

Display Eight edge-lit indicators (7 digits + caption) with automatically positioned decimal point. *Accuracy* ±1 count ± accuracy of standard. *Display resetting* Manual, automatic or pulse. *Frequency measurement* Range 0 to at least 10Mc/s. *Gate times* 0·1, 1·0 or 10s with caption and decimal point; 0·01 and 0·001 without. *Sensitivity* High impedance (10c/s to 10Mc/s) 100mV to 250V r.m.s. or non-sinusoidal inputs up to 400V pk. Low impedance (10c/s to 10Mc/s) 100mV to 6V r.m.s. into 50/75Ω. V.L.F. (0 to 10kc/s) 2V to 50V into 5kΩ. *Time measurement* From 0·5μs to 10^8s. *Period measurement* 1, 10, 10^2, 10^3, 10^4 or 10^5 cycles of the input waveform with 10^7 p.p.s. timing. *Counting* 1 to 9999999 totalling over any period. *Frequency standard* INTERNAL 5Mc/s crystal oscillator HCD15 oven controlled at +50°C. Accuracy ±2 parts in 10 over the range 0 to 45°C. EXTERNAL Any sinusoidal signal from 1kc/s to 1Mc/s of amplitude between 1V and 10V r.m.s. or suitable pulse signal. *Check* Self-checking facilities incorporated. *Operating temperature range* 0 to 40°C (ambient). *Power requirements* 90 to 130 V and 200 to 240V, single phase. 40 to 100c/s, 40W. *Dimensions* 18in (45·7cm) wide × 13in (33cm) high × 11in (28cm) deep. *Weight* 35lb (15·9kg).

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By IRVING SPACKMAN

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A discussion on designs for new receivers or transmitters usually brings to light the problem of how to design or calculate suitable coil-condenser combinations for a particular frequency coverage. In many cases the problem resolves itself around the use of an existing condenser arrangement. It is usually easier to design coils to accommodate an existing condenser gang than to acquire a suitable condenser gang to fit in with existing coils. Therefore, let us start first with the tuning condenser.

We will assume for the purposes of this worked example that we have a three-gang tuning capacity of 50 pf. per section. We wish to use it in a receiver tuning the range 3.5 mc/s to 4.0 mc/s, i.e., a 500 kc. tuning range. The R.F. and Mixer interstage tuned circuits will tune 3.5 to 4.0 mc/s as above, but the oscillator will need to tune 3.95 to 4.45 mc/s if we assume the use of an I.F. frequency of 450 kcs.

Now the 50 pf. capacity does not have a 50 pf. tuning range, there will be some minimum capacity. (If the gang has trimmers, then the minimum capacity will be determined by these.) Let us assume that there are trimmer capacities present, range 3 to 30 pf., and that the minimum capacity of the gang itself is 5 pf. If the trimmers are all set at half capacity, then the minimum capacity of each section of the gang will be say 20 pf. and the maximum will be 65 pf., i.e., the tuning range is 45 pf.

Now the formula to calculate the parallel capacity needed across a capacity swing of 45 pf. to tune 3.5 to 4.0 mc/s is as follows:

$$\text{C padding} = \frac{\text{C variation}}{\frac{(F_2)^2}{(F_1)^2} - 1}$$

where F_2 is the highest frequency F_1 is the lowest frequency.

$$= 45/[(4^2/3.5^2)-1]$$
$$= \frac{45 \times 12.25}{3.75}$$
$$= 145 \text{ pf. approximately}$$

Therefore the total C = 145 + 45 = 190 pf.

The padding capacity can be a 150 pf. silver mica, the difference can be taken up with the trimmers.

Now the oscillator section is calculated in a similar manner:

$$\text{C padding} = 45/[(4.45)^2/(3.95)^2-1]$$
$$= \frac{45 \times 15.5}{4.5}$$
$$= 155 \text{ pf.}$$

C total = 155 + 45 = 200 pf.

(please turn to page 33)

ENQUIRY CARD AD. 17

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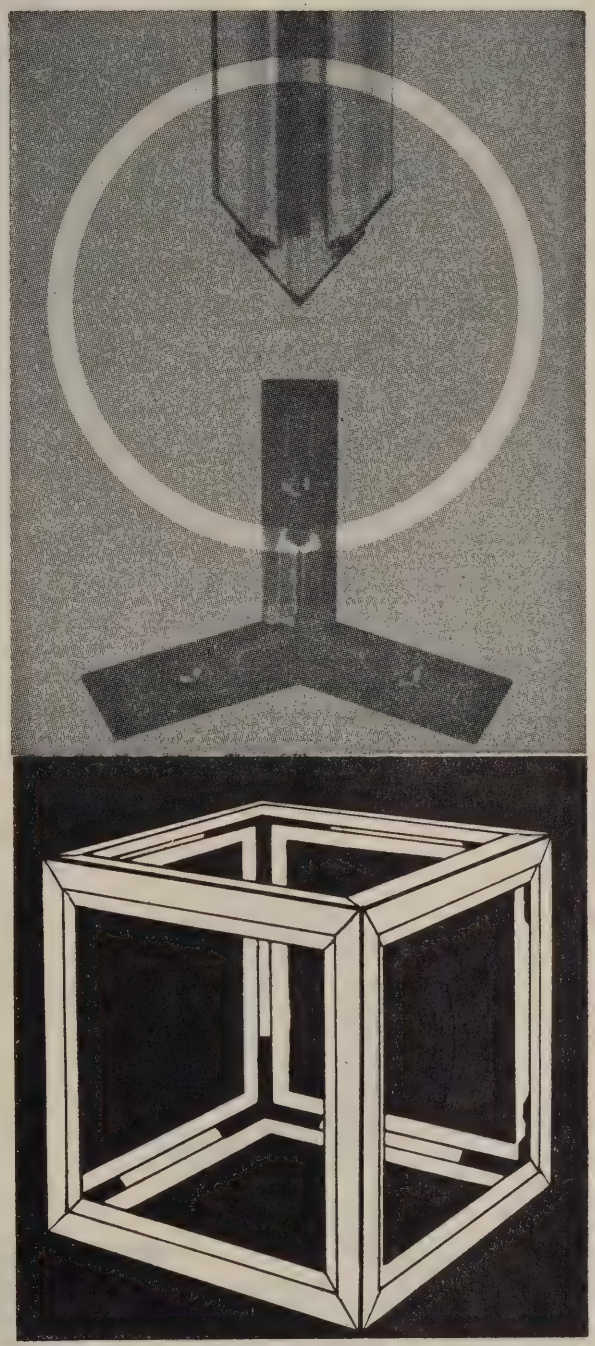

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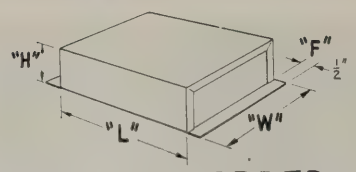

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By

J. C. G. GILBERT, Assoc. I.E.E., M.I.E.R.E., F.T.S., A.Mus.T.C.L.,
Head of Department of Telecommunications Engineering,
Northern Polytechnic (London)

For four days (April 2 to 5) the Russell Hotel in London was invaded by nearly 40,000 visitors intent on enjoying the latest products of the audio industry on the occasion of the International Audio Festival and Fair.

British manufacturers of high-quality sound reproducing apparatus welcomed the opportunity of showing and demonstrating their equipment against the best from Canada, Denmark, Germany, Hungary, Japan, Norway, Sweden, Switzerland and the United States of America. For the first time, the public heard some experimental stereo-multiplex radio transmissions radiated from the British Broadcasting Corporation's frequency modulation transmitter at Wrotham, Kent, some 30 miles from London. The co-operation of the B.B.C. in providing the daily transmissions whetted the interest in stereo radio, which, like transmission already taking place daily in some other European countries, was based on the American Zenith-G.E. multiplex system.

Although manufacturers only had a few weeks' prior notice of these important experimental transmissions, several British decoders were demonstrated and some impressive results were heard in the domestic-like listening rooms. The Festival and Fair consisted of an exhibition on the ground floor of the hotel, while the four upper floors were denuded of their normal furniture and converted into demonstration rooms. Thus visitors had an opportunity of inspecting the products and discussing their merits at the exhibition and then visiting the demonstration rooms.

Undoubtedly the outstanding new contributions to high-quality reproduction were the transistorised amplifiers; the performance of these was at least as good as, and in several instances better than, comparable valve-operated amplifiers. It is of interest that whereas in the U.S.A. transistor amplifiers of comparable performance to valve types are more expensive than the latter kind, one British manufacturer (1) introduced a model that was slightly cheaper than the valve type. This transistorised integrated amplifier is only 48 per cent. of the weight, 43 per cent. of the size and 89 per cent. of the cost of its valve predecessor. Visitors were given the opportunity of comparing the two systems by means of an unmarked

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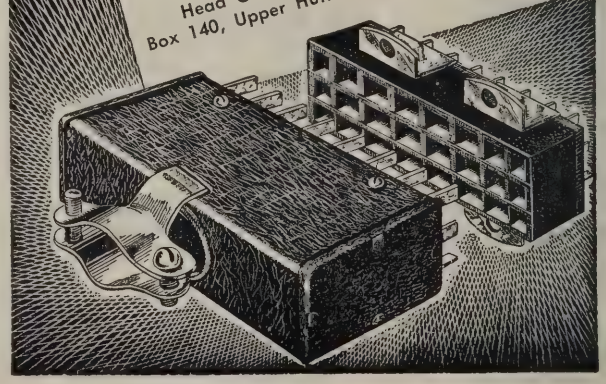
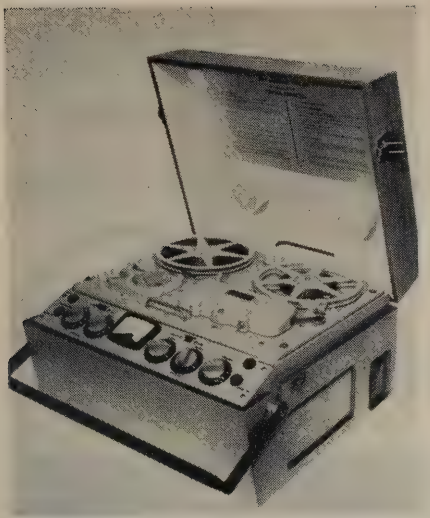




The Clarke and Smith TR634 ten-watts output tape recorder seen in this photograph is suitable for use in large halls. This British unit has two transistorised amplifiers, one for recording and the other for replaying. Tape speeds are 7.5 and 3.75 inches (19 and 9.5 centimetres) per second. Distortion at maximum output is said to be less than 1 per cent. at one kilocycle, and the frequency responses are 50 cycles to 15,000 cycles and 50 cycles to 9,000 cycles (plus or minus three decibels in each case) at tape speeds of 7.5 inches and 3.75 inches, respectively. (Clarke and Smith Manufacturing Company Ltd., Melbourne Works, Wallington, Surrey, England.)

This new British free-standing, doublet loudspeaker utilises an electrostatic drive instead of the commonly used moving coil. Most of the objectionable resonances produced by the latter type of loudspeaker, which have to be smoothed out as far as possible, are not energised in an electrostatic unit. This improves the loudspeaker's ability to deal with all parts of the sound spectrum equally and so reproduces sound with enhanced realism. The new Quad loudspeaker must be used with a standard Quad power amplifier or one specifically designed for it. (Acoustical Manufacturing Company Ltd., Huntingdon, England.)

changeover switch—but very few could differentiate between them.

A newcomer to the amplifier field, but one with a world-wide reputation for tape decks and complete tape recorders (2) sprang a surprise with a transistorised amplifier that has a wide range of controls and input signal circuits.

Loudspeaker Units

Of all the component parts used in a high-quality audio system the loudspeaker gives rise to the most controversy. Over the years the basic moving coil system—with the one brilliant exception of a full-range electrostatic loudspeaker (3)—has been the fundamental method of translating electrical energy into sound, and in general terms the larger the enclosure the wider the frequency range of the reproducer.

However, the advent of stereophonic reproduction requiring two large enclosures caused designers to investigate and experiment with smaller loudspeaker units and enclosures. Two completely new models shown at the Fair created considerable interest. One was only ten-and-a-half inches high, five-and-a-half inches wide and seven-and-a-half inches deep yet it can handle eight watts power with a claimed frequency response of 45 to 20,000 cycles per second. Two such units could be hidden on a bookshelf and an outstandingly good performance enjoyed. The unit contains two small diaphragm moving coil loudspeakers, each diaphragm having a considerable degree of movement (4).

The second new loudspeaker (5) differed in that a massive ceramic magnet was used to drive a four inch diameter metal diaphragm. The unit is rectangular and uses heavy perforated metal as the outer case. It was said to be completely unaffected by adverse climatic conditions and to be insect proof. A single unit mounted in a suitable enclosure will handle an output of twelve watts, and where greater power handling is required a number of units can be stacked one above another in a single enclosure.

An unusual loudspeaker system from Canada (6) consisted of two 18 inch diameter spheres mounted at opposite ends of a long, low cabinet that housed the amplifier, radio receiver and record player. The spheres are of spun aluminium and can be rotated through 340 degrees of arc. It is claimed that by correctly positioning the spheres, their directional quality will compensate for varying acoustic conditions.

Record Changers

A striking demonstration was given at the Fair of a modern record changer with a lightweight carrying arm and high-compliance cartridge (7). Not all records are perfectly flat and occasionally the turntable spindle hole is not concentric with the recording. This new record-changer should overcome many of the objections from the purist who prefers a "professional-quality" turntable and a separate carrying arm using his favourite cartridge.

But even for a perfectionist, one British pick-up arm (8) could only be improved by modifying its packaging. In the past each purchaser has had to assemble the arm from carefully packaged parts, but the introduction of preformed, closed cell expanded polyvinylchloride packaging has enabled the manufacturer to send out the arm completely assembled to any part of the world.

Tape Recorders

Tape recorders were well represented and one new British design recently introduced can compete with the best from overseas. So correct was the original basic design that after 17 years its modern counterpart still bears a strong family resemblance (9). The unit forms the basis for a range of monophonic and stereophonic recorders of semi-professional standard. Also, other manufacturers use the same deck but fit their own recording and reproducing amplifiers (10, 11).

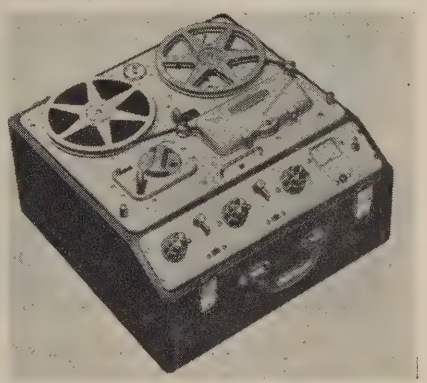
Microphones

Although tape recorders are usually used with a cable-connected microphone there are occasions where it is desirable for the microphone to have complete freedom of movement. Thus the radio-microphone, which consists of a small moving-coil microphone unit containing a crystal-controlled frequency-modulated battery operated transistorised transmitter with a range of several hundred yards (metres). At the receiving point is a crystal-controlled receiver that can be fed into a tape recorder or amplifier system (12).

Another unusual microphone seen at the Fair came from Austria (13); this had built-in, variable reverberation. Thus, for dance music, one artist can use a microphone with facility for reverberation, while the backing orchestra can use conventional types. With this type of music quite impressive results were heard, while in another demonstration room (14) an electronic reverberation unit could be introduced to any form of music or speech.

Sad as it may seem to some this was the last occasion on which the Audio Festival and Fair will be held at the Russell Hotel, for the exhibition has outgrown this accommodation and next year a larger site will be used. Really high-quality sound reproduction started in Britain and it is pleasing to report that the best of the country's audio equipment can still outplay the products from overseas even though, as the years pass, the margin of advantage narrows.

(1) H. J. Leak and Company Ltd.; (2) Truvox Ltd.. (3) Acoustical Manufacturing Company Ltd.; (4) Goodmans Industries Ltd.; (5) Boosey and Hawkes (Sales) Ltd.; (6) Argelane Ltd.; (7) Garrard Engineering Ltd.. (8) S.M.E. Ltd.; (9) The Ferrograph Company Ltd.; (10) Vortexion Ltd.; (11) Clarke and Smith Manufacturing Company Ltd.; (12) Lustraphone Ltd.; (13) Politechna (London) Ltd.; (14) K.E.F. Ltd.



Ferrograph series 420 tapedecks are capable of mono recording and playback, with continuous monitoring on either channel, and stereo recording and playback, with continuous monitoring on both channels. Tape speeds are 7.5 and 3.75 inches (19 and 9.5 centimetres) per second, and the frequency responses are 40 to 15,000 cycles per second at the higher speed, and 50 to 10,000 cycles per second at the lower (plus or minus three decibels in each case). The output is at low level—one volt across 5,000 ohms for each channel—as the deck is intended for use with external loudspeakers and power amplifiers. (The Ferrograph Company Ltd., Ferrograph House, 84, Blackfriars Road, London, S.E.1.)

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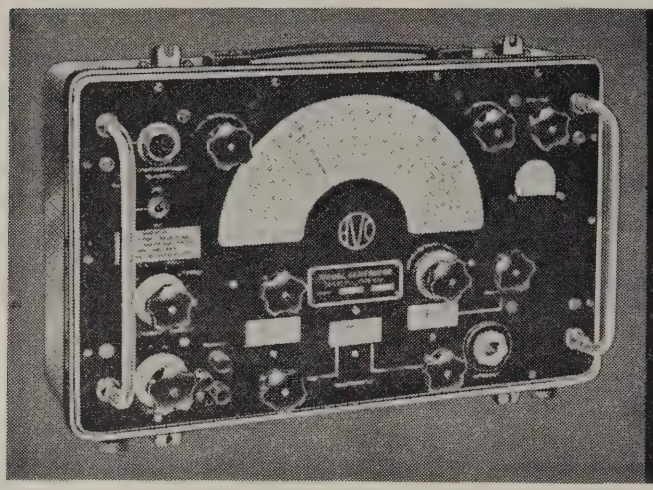
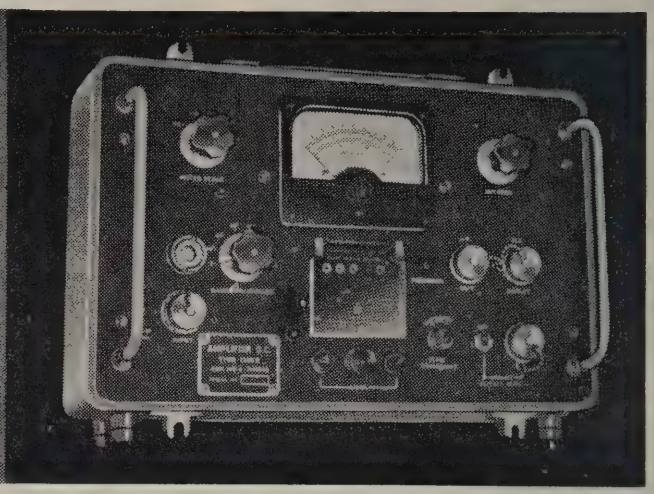


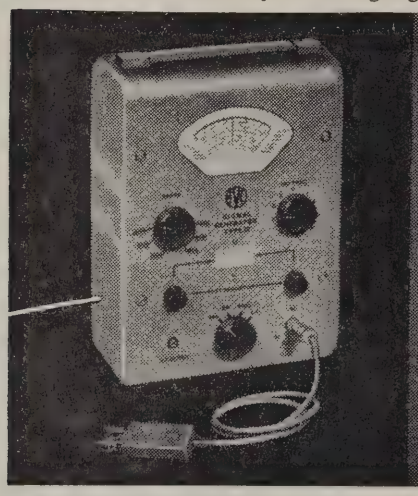


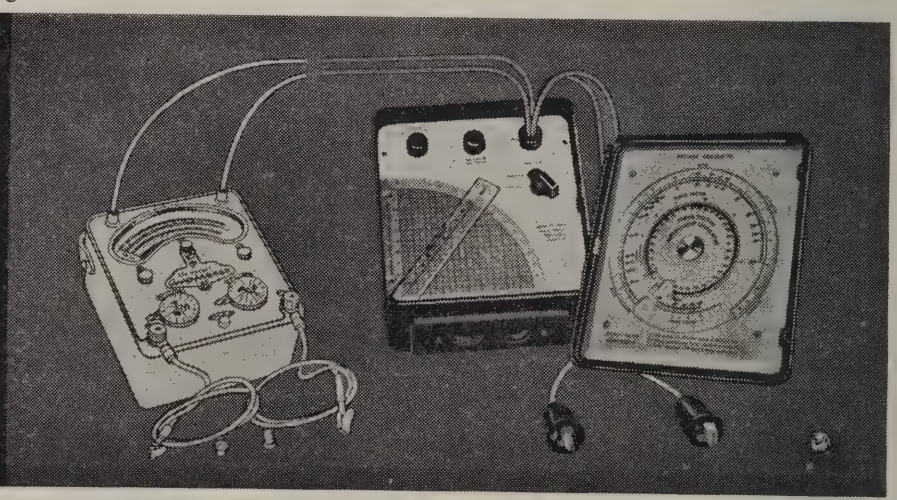
AVO Signal Generator, Type 111

An inexpensive general purpose a.m. signal generator of entirely new design for the service engineer.
The new design of attenuator, coupled with adequate double r.f. screening, results in a remarkably close adherence of the output to the attenuator calibration, combined with a very low leakage figure.

AVO portable d.c. amplifier

A highly stable d.c. amplifier which has been primarily designed to measure the minute currents produced in ionization chambers, but it has applications in medicine, industry and experimental work in connection with reactor instrumentation.





AVO signal generator, Type 378

This instrument will provide r.f. signals between 1uV and 250mV into a 75 ohm load at any frequency between 2/Mc/s and 225/Mc/s, this being accomplished in 7 ranges.

Universal Avometer power factor and wattage unit

This unit which works in conjunction with the Model 7 AvoMeter or the Model 40 AvoMeter (2 models available) brings power factor and wattage measurements within the scope of every engineer without a great capital outlay.
The accuracy is far higher than is usually required for commercial purposes.
There is also a full range of AVO Test and Measuring Instruments.

A3.4

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APPENDIX TO "MOBILE EQUIPMENT" SERIES

—continued from page 29

Now we must calculate the inductance required with these capacities to tune the required frequency ranges.

The formula is simply

$$L = \frac{25{,}300}{(\text{highest frequency})^2 \times \text{C minimum}}$$

$$= \frac{25{,}300}{(4)^2 \times 145}$$

Approximately = 11 microhenries

The same result will be obtained if an L-C-Frequency Abac is used, for example the Wireless World Radio Data Charts or the Coil Winding Charts in the Radio Data Reference Book published by the R.S.G.B.

For the oscillator section, using the same formula we have an inductance of approximately 8.25 microhenries.

Now let us design the coils. Take for example the common 0.3 inch diameter Slug-tuned "Neosid" formers with shield cans. These are widely available in several lengths, but the shorter types are quite suitable for our purposes here.

First consider the effect of the dust core. For coils of length between $\frac{1}{4}$ and $\frac{3}{4}$ inch the type 900 cores will enable the inductance to be adjusted over a range up to at least 50% more than the inductance value without the slug. Obviously then we can reduce the calculated coil inductance values by about 25% to enable efficient use of the "slug" and simplify adjustment. Therefore the inductance of the antenna and R.F. coils without slug should be in the vicinity of 8.5 microhenries, whilst the oscillator coil (if it is to be slug tuned) should be in the vicinity of 6.5 microhenries.

A simple chart for determining winding data is found in the R.S.G.B. data book. With the aid of this chart the number of turns per inch of a given wire for a given inductance can be determined for these coil formers. For example, with 30G wire, the 8.5 microhenry coil should be 0.8 inch long close wound. From the wire tables 0.8 inch of 30 gauge enamel wire at 72 turns per inch is approximately 58 turns. For the base windings L2 and L4 (see circuit) eight turns of the same gauge wound close to the earth end of L1 and L3 are near optimum.

For the oscillator section which requires 6.5 microhenries a coil of 0.8 inch of 28G enamel with 48 turns would be satisfactory. Alternatively using 30G wire again, we require a coil 0.65 inches long with 47 turns.

In either case the coil has taps at 5 turns and 25 turns for emitter and collector connections.

In this discussion we have not introduced other design problems such as the calculation of the Dynamic impedance, or Q factor, of the coils. Providing the ratio of capacity to inductance does not become ridiculously high or low then the design data will give tolerable results, if not technically exact. The correct way, of course, is to use all the data and start from scratch, but this ultimately presupposes that once a tuning capacitor had been finally determined in the calculations, that such an item would be available. Unfortunately in many cases this is not so, and the variation of the adage which states "a capacitor on the shelf is worth many in the catalogue" becomes painfully evident. If there is demand for an article on the full design treatment for RF coils in these applications, the author could prepare such an article at a later date.

SERVICEMAN'S COLUMN

—continued from page 23

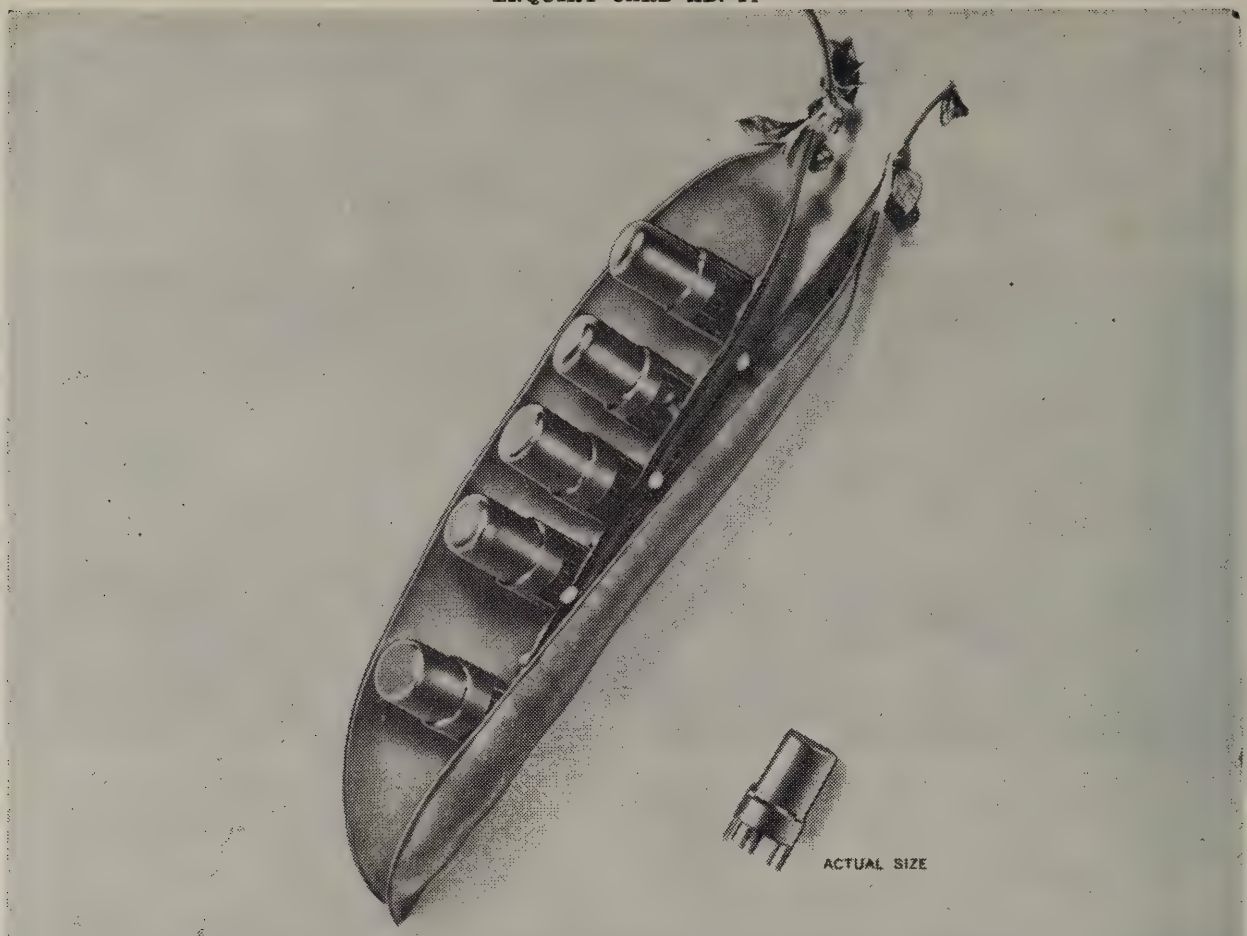
which at least made it possible to get voltage readings on the valve sockets. There was no voltage on the plate of the mixer valve, so an attempt was made to investigate further, but due to the extremely cramped arrangement of parts it was difficult to see much of the inside as the switch and the valve shields (which were fixtures) took up most of the space and obscured the other components. It was possible to trace the wiring from the mixer plate connection to the output coil and when a resistance check of the coil was made it was found to be open circuit. I must admit at this point I nearly put the covers back on, but instead decided to have a closer look at the coil. The bottom connection was obscured, being attached to a lug which held the coil to the board, the top connection was also taken down to the board but through a piece of sleeving. Realizing the "dis" was more likely to be inside the actual winding I nevertheless carefully tugged the end of the wire where it entered the sleeving—it came away without any resistance (not ohmic!), showing a familiar green discolouration at the end. A continuity check then showed the coil itself to be O.K. so the next step was to solder on an inch of 5 amp fusewire, thread on a piece of half-mil spaghetti and push the wire through the previously cleared hole in the P.C. board. Oh! for a solder-sucker though! What a boon one would be for P.C. board unsoldering operations.

Well after that everything was back to normal and an inspection of the IF curve on the 'scope showed it to be exactly in accordance with the manufacturer's specification, it didn't even need a touch up of the mixer plate coil slug!

Now it may be argued that such a repair might not be as reliable or long lasting as if the whole tuner were replaced. This might be true if the replacement tuner were a new one instead of being a reconditioned unit which could happen to be older than the one being replaced.

Being brought up on the tradition of twelve months' guarantee on service work I would be quite prepared to extend such a guarantee to the customer in this case, which is more than the manufacturer of a new tuner is prepared to do anyhow!

ENQUIRY CARD AD. 14



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Nuvistor circuits are virtually free of replacement mismatch problems.

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Because the nuvistor you use will match the performance characteristics of the one it replaces. In addition, extended life tests also prove nuvistor characteristics are exceptionally stable throughout life. Note the tight range of transconductance values for each tube listed at right. Most important to you is the fact that no nuvistor tested either exceeded or fell below its initial specified gm range values during the first 2,000 hours of tests.

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Type No.	Description	Transconductance Range Values* (micromhos) Max.	Min.
RCA-7586	general-purpose medium-mu industrial triode	13,000	10,000
RCA-7895	general-purpose high-mu industrial triode (mu 64)	10,900	7,900
RCA-7587**	general-purpose sharp-cutoff industrial tetrode	12,200	9,000
RCA-8056	medium-mu triode for low voltage power supply and small-signal amplifier applications up to 350 Mc.	8,000	6,000
RCA-8058	double-ended high-mu triode for cathode-drive amplifier service up to 1200 Mc.	14,800	10,000

*with 6.3 volts ac or dc on heater **tetrode, dc grid #2 volts = 50

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On Our Bookshelf . . .

There has been a large number of books published about Semi-conductors and Semi-conductor techniques, and we therefore have quite a number for review.

The first book for review this month is entitled "**Basic Theory and Application of Transistors**" published by Dover Publications Inc., New York.

This text is an unabridged and corrected republication of a Technical Manual issued by the U.S. Army Dept.

It is a concise coverage of the theory and application of transistors, and is ideal for those who do not have a wide knowledge of physics. The first of thirteen chapters serves as an introduction to the fundamental transistor theory which is found in the second of the two introductory sections. Chapters 3, 4 and 6 cover transistor amplifier fundamentals, equivalent circuits, typical parameters, curves and characteristics. Chapter 5 introduces and discusses the various methods of stabilisation of the bias conditions in transistors.

Chapter 7, the longest in the book, with eight sections requiring some 30 pages, discusses many aspects of audio amplifiers, resistance and transformer coupled stages, volume controls, phase inversion, power amplifiers, and compound connected transistor systems.

Chapters 8, 9 and 10 cover tuned amplifiers, wide band amplifiers and oscillators. The various methods of tuned amplifier neutralisation are described, and A.V.C. systems, L.C. and R.C. oscillators are discussed here in detail. The next section, which is Chapter 11, does not follow quite so logically as Chapter 12, which discusses modulation, mixing and demodulation. Reverting to Chapter 11 we have a section covering Pulse and Switching circuits.

The text is very well appointed with drawings, characteristic curves and photographs, there being a total of 240 in a total of 243 pages. The last chapter, 13, discusses a variety of additional devices, such as photo sensitive transistors, the tetrode transistor, the spacistor and unijunction transistor. The appendix outlines the most useful range of letter symbols and a very well appointed glossary of unusual terms and an index concludes this very instructive and useful text. At the price of 12/6 this book should find its way on to the book shelf of every person working with transistors.

Our copy by courtesy of Technical Books Ltd.

* * *

The staggering advances in semiconductor technology are shown in the number of new books being published on this subject. The reviewer has six sitting in front of him, for reading, assimilating (if possible) and review. Whilst it is not intended that we will deal with all of these, one was of more than particular interest. This book, entitled "Tunnel-Diode and Semiconductor Circuits," by John M. Carroll, managing editor Electronics Magazine, is published by McGraw-Hill Book Co.

This book, of some 400 large pages, was compiled from carefully revised articles featured in "Electronics" magazines. The managing-editor, Mr. Carroll, has amalgamated these into a series of articles on Tunnel Diodes, Micro-electronics, Hall Effect devices, Varactor Diodes, Parametric, Field Effect and Thermo-electric devices, Four-layer diodes, Silicon Controlled rectifiers, Unijunction transistors and others. In each case, the articles are arranged to give an introduction and basic description of the device, then follow papers detailing the physical effects upon which the device depends, together with a discussion of its action and properties, manufacturing techniques, etc., then the theme of the papers becomes more practical with working and typical equipment being discussed and described.

Because of the many authors, it is naturally impossible to review the book as one person would do if written by one or several people in collaboration. Most articles are further expanded by lists of references. However, to furnish readers with some concept of this book, we will break it into sections. Tunnel Diodes occupy nearly half the book, with 38 articles made up into 7 chapters. These cover many phases of amplifiers, oscillators, switching and memory circuits.

In Chapter 9 there are 9 papers assembled on the subject of micro-electronics, micro-miniature circuits, matrix and logic blocks, etc. Chapter 10, with 7 papers on Hall-Effect devices and their applications leads into Chapters 11 and 12, the former co-ordinating 8 papers on Voltage Variable capacitors, the latter, 7 papers on Parametric amplifiers and varactor diodes. Chapters 13 and 14 are devoted to lesser known devices, such as Field Effect Devices (4 papers) and Thermo-electric devices and their applications (4 papers). Chapters 15 and 16 cover the 4 layer (P.N.P.N.) Diodes and silicon controlled rectifiers. In chapter 15 there are 6 articles on the subject, in Chapter 16, there are 15 papers.

Chapter 17, another large section, covers the lesser known species of semi-conductors known as the Unijunction transistor. With 12 articles, there is quite a comprehensive coverage of this subject. Chapter 18 winds up the text with 5 papers on special semiconductor devices, followed by several pages of further comments and data and quite a useful and extensive index.

With such a weight of material, the book took some time to read, but much pleasure and information was gained in so doing. This book is highly recommended for a text, for reference and for an enlightening trip through the rapidly expanding semi-conductor galaxy.

Our copy by courtesy of the publishers.

I.H.S.

ENQUIRY CARD AD. 9

It was good to meet so many of you at the International Trade Fair here recently. Some of you we knew of old and some were new friends. To all of you we say thank you for taking the time to look at our display and in some cases placing orders with us.

We trust you enjoyed having a browse over some of the fine equipment we had displayed and we hope to hear from you again very soon.

HEATHKIT is our specialty line proved over long years of service, overseas and locally. Used wherever good equipment at reasonable cost is required HEATHKIT have made a mark in all phases of Instrumentation, Amateur Broadcasting, Marine, Educational and Scientific.

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On the Record . . .

By RAY WILSON, Mus. Bach.

BEETHOVEN: "Emperor" Concerto. Philharmonic Orchestra, Leopold Ludwig conductor, with Emil Gilels. World Record T2 727.

Once again the youngish Russian pianist Gilels presents us with an authentic, thrilling performance of one of the great piano classics. I was quite exhilirated by this recording. There is a lot of routine stuff to be heard these days, where every note is in place, the sound recording good and the composer reasonably well served, but somehow the spirit of contact between artist and public is lost. Some of us would rather hear the odd split note and faulty orchestral entry if the performance hangs together with an inner compulsion. Performances of the "Emperor" which fall into this class are few and far between, and I suspect as far as recordings are concerned the same would apply.

I wonder how much of this spontaneity is lost by the technique of modern recording—where every effort is made to present a faultless disc from the technical side, and the continuity of performance is lost. Whether or not Gilels recorded this in bits and pieces, we are presented here with as fine a version as one could wish for. Particularly noteworthy is the loving care with which the soloist observes the composer's dynamic markings. Beethoven above all other composers requires this attention.

The orchestral accompaniment is very good, with some fine woodwind playing, although the strings are not as smooth as one would like at the end of the last movement. I recommend this as a first-class recording, and am not sure it is not the best available by the younger generation of pianists.

MOZART: Mass No. 14 in C Major, K 317 "Kronungsmesse."
HAYDN: Salve Regina No. 3 in G Minor. Soloists and chorus with London Mozart Players conducted by Harry Blech.
Record Society Edition 6075.

These two short choral works deserve more frequent hearing, particularly the Haydn. This disc is evidently a re-issue of a few years ago and wears very well. Sung discreetly by an anonymous group, the choral parts are clear with excellent enunciation and intonation. The accompaniment matches this singing in quality, and it is only in the overall direction that I feel something is lacking. Blech is rather unimaginative, particularly in the Coronation Mass, evidently being misled by the comparative sparseness of directions in Mozart's score.

However, as the Haydn does not seem to be available in another version I think most music lovers who wish to have examples of the church music of the late 18th century would do well to consider this recording. The sound engineering is good.

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NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

WESTINGHOUSE ENTERS HOME ENTERTAINMENT COMPONENTS FIELD

NEW YORK, New York, U.S.A.—Westinghouse has announced its entrance into the home entertainment components field with the introduction of three new products:

—Solid state FM-AM stereo multiplex tuner/amplifier.

—Custom speaker system, with 4-inch tweeter and 6-inch base speaker.

—Custom four-speed automatic turntable.

The amplifier features illuminated slide-rule tuning for both bands, and an automatic frequency control which assures drift-free FM performance. The unit contains jacks for stereo tape and phonograph input, plus remote speaker and tape output. There also is a stereo headphone jack.

In addition, the amplifier contains an auxiliary AC outlet for a tape recorder or automatic turntable.

Designed to complement the amplifier, the speaker system also comes in an oil walnut veneer. The speaker enclosure may be purchased as a single unit, or as a pair for stereo enjoyment. A 12-foot speaker cord will permit the use of two units some 24 feet apart.

Completing the components line is the four-speed automatic turntable which permits 4-speed automatic or manual operation. The chrome-plated counterbalance tone arm, which contains a diamond stylus in a retractable, ceramic stereo cartridge, tracks as low as two grams. The turntable, which has a built-in stylus brush and a 45 rpm spindle, comes in an oil walnut veneer base.

ENQUIRY CARD 34

* * *

MALAYSIA ADOPTS CROSSBAR TELEPHONE SYSTEM

The AT&E Crossbar telephone system developed by Automatic Telephone & Electric Co. Ltd., has been selected after protracted and exacting technical evaluation by the Malaysian Telecommunications Department in Kuala Lumpur for installation initially in four areas.

This AT&E Crossbar equipment, valued at approximately a third of a million pounds sterling, will be installed in Setapak, Batu, Salak South and Petaling North.

AT&E crossbar was selected by the administration on its technical merit—because it is the world's most modern common-control telephone system currently in quantity-production specifically designed to interwork with all accepted world systems of telephone switching. It largely eliminates the need for costly additional interworking equipment.

AT&E crossbar equipment was also selected for use at the Sydney "Gateway" terminal exchange of COMPAC (Commonwealth Pacific Cable linking the three continents of Australia, North America and Europe).

ENQUIRY CARD 33

* * *

CHANGE OF NAME

As from 1st August, 1964, the British General Electric Company has been renamed G.E.C. (New Zealand) Ltd. It is felt that the new name will associate the company more closely with its products, most of which already bear the G.E.C. Symbol.

ENQUIRY CARD 35

* * *

NEW PHILIPS MILLIVOLTMETER GIVES TRUE INDICATION OF RMS VALUE

For measuring RMS values of both sinusoidal and non-sinusoidal voltages Philips have developed a new millivoltmeter, type PM 2520. It uses two identical amplifiers arranged symmetrically with respect to earth, thus enabling both earthed and floating measurements (suppression factor greater than 60 dB) to be carried out.

There are 12 voltage ranges from 1mV to 300V f.s.d. For easy readjustment two internal calibration voltages (10 mV and 3 V) are provided. The frequency range is from 10 c/s to 1 Mc/s with high accuracy. The max. crest factor (peak/RMS ratio) of

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SEPTEMBER, 1964

NEW PRODUCTS—*Continued*

the signal to be measured can be 5.

The input impedance of the range 1 mV to 1V is for symmetrical measurements 8 MΩ//15 pF and for assymetrical measurements 4 MΩ//30 pF. For the range 3 V to 300 V these values are 20 MΩ//7.5 pF and 10 MΩ//15 pF respectively.

For displaying signals on an oscilloscope, a special amplifier output with a gain of 40 is provided. A recorder output (10 mV at f.s.d.) is also provided.

ENQUIRY CARD 36

* * *

NEW POSITIVE TEMPERATURE COEFFICIENT THERMISTORS

Two positive temperature coefficient (PTC) thermistors, types 802 and 834, are available from the Westinghouse Semiconductor Division. These thermally sensitive devices "switch" or rapidly increase in resistance when their temperature exceeds a certain value. Five nominal switching temperatures covering the range from 65 degrees C to 155 degrees C are available.

The dissipation constant for the 802 thermistor is 15 milliwatts per degree C at 25 degrees C ambient with a maximum power dissipation at this temperature of two watts and an insulation capability of 1000 volts. The 834 thermistor has a dissipation constant of 11 milliwatts per degree C with a maximum power dissipation of 25 degrees C of one and one-half watts and an insulation capability of 600 volts.

ENQUIRY CARD 37

* * *

NEW POCKEL'S CELL LASER Q SWITCH

A Pockel's cell laser Q switch that has high efficiency and a low power requirement has been built by the Aerospace Division of the Westinghouse Defense and Space Center. Developed as a modulator for use in optical radar and laser communication work, it provides a very high data transmission rate.

The solid-state device is an optical shutter that controls the Q of a laser cavity. This type of a device, sometimes called a Q spoiler, causes the laser cavity to radiate short, high-power pulses instead of a series of lower power pulses within an identical time period.

The quality factor Q is the measure of the relationship between stored energy and rate of energy dissipation.

The new Q switch has two crystals in contrast to conventional Pockel's cell modulators which have one crystal. Because of a unique design, the driving voltage requirement is reduced and the metallic film transparent electrodes used in other such modulators have been eliminated.

In laboratory tests, 50-nanosecond-wide pulses of laser energy with peak powers in the megawatt region have been obtained using the new laser Q switch. Engineers at the Westinghouse division expect that refinements of the device will enable them to reduce driving voltages to a few hundred volts and produce significantly shorter pulse widths.

ENQUIRY CARD 39

* * *

COMMUNICATIONS CONSULTANT TO PLESSEY-UK LIMITED

Captain C. F. Booth, CBE, MIEE, who until his recent retirement after 40 years' service was Deputy Engineer-in-Chief at the Post Office, has been appointed Communications Consultant to Plessey-UK Limited.

Captain Booth is well known for his work in the international field on behalf of the International Telecommunications Union. Through this work he has made an international contribution to the orderly development of radio systems, including television broadcasting.

Prior to his retirement from the Post Office, he was responsible for the design and installation of the Goonhilly Down experimental satellite radio relay station.

He has served as Chairman of the Radio Section of the Institution of Electrical Engineers, and is a holder of the Institution, the Duddell and other premiums for contributions on communication topics.

ENQUIRY CARD 38

* * *

TWO NEW MARCONI SOLID STATE INSTRUMENTS

The new Marconi designed M.F./H.F. A.M. Signal Generator type TF 2002 gives high quality a.m. outputs from 10 kc/s to 72 Mc/s and features high discrimination (effective scale length of more than 2½ miles), exceptionally low leakage and spurious modulation, and a rugged compact construction. Weighing only 50lb. it is available in bench or rack mounting form and can be powered by mains or batteries.

Crystal check points are available at intervals of 1 Mc/s, 100 kc/s or 10 kc/s with subsidiary points at ±1 kc/s relative to the main points for use in bandwidth measurements. Above 100 kc/s carrier frequency a direct-reading incremental tuning control, which can be standardized against the crystal check points, gives a discrimination of 0.025% of carrier frequency.

Output up to 2 V source e.m.f. at 50Ω is obtained via 20 dB and 1 dB step attenuators and is stabilized during tuning by automatic level control. Internal a.m. up to 100% is produced by a continuously tuned oscillator covering the audio band. Envelope negative feedback ensures good modulation quality up to at least 80% and modulation depth is independent of both carrier tuning and carrier level. External f.m. or phase modulation can be applied.

The solid state Counter, Type TF 2401, comprises a basic instrument into which plugs a Frequency Range unit and a Function unit. The Range Unit determines the maximum input frequency which may be measured; the Function unit determines the type of measurement which may be made. The plug-in units at present available are a 50 Mc/s Frequency Range unit, a Counter/Timer Function unit, and a 500 Mc/s Converter unit.

Features include an 8-digit readout with memory, measurement units illuminated in the display window, and a self-check facility.

A printer or remote readout may be driven by the Counter, and as an optional facility the instrument may be adapted to accept control from a remote source. The instrument can also be used as a time interval generator, providing pulses from 0.01 c/s to 1 Mc/s in decade steps; 1 Mc/s and 10 Mc/s outputs are also available on separate sockets.

ENQUIRY CARD 40

* * *

DATAPULSE ANNOUNCE MODEL 106A PULSE GENERATOR

Repetition rates to 12mc, pulse amplitudes to 12v into 50 ohms, and single or double pulse outputs are features of the new Datapulse 106A Pulse Generator.

Other new features include effective 20mc rep rates on double pulse mode and pulse widths from 25 nanosec. to 5 millisec. All other specifications of the previously available Model 106 have been retained, including linear variable rise and fall time control from less than 10 nanoseconds.

Jitter is less than 0.1%. Accuracy is within ±5%. Waveform aberrations are typically less than ±2% above 300 mv. Automatic scaling and amplitude reduction occur at duty cycles greater than 70%. Output stages are also protected against short circuits of any duration and will tolerate back voltages up to ±10v.

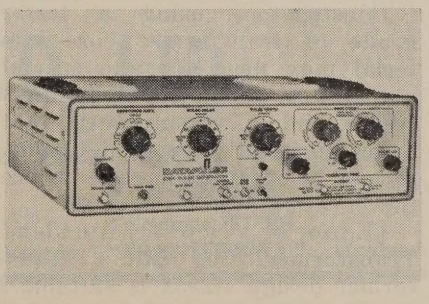
A front panel pushbutton permits single cycle operation. Positive and negative outputs of multiple units may be mixed with each other or with other outputs through a common 50 ohm load returned to ground.

Also, Datapulse are now producing the model 108 Pulse Generator which features output of 50V into 50 ohms at 10 mc and less than 2% overshoot at 7 nanoseconds rise time.

The 108 also offers solid state circuitry, variable rise time from 7 nanoseconds to .05 μsec., pulse widths from 20 nanosec to 5 millisec at up to 50% duty cycles and up to 5 millisec variable delay from internal or external triggers.

Passive attenuation control, designed through pulse reflection techniques, provides excellent waveform of any amplitude from 200 mv to 50 v.

ENQUIRY CARD 41

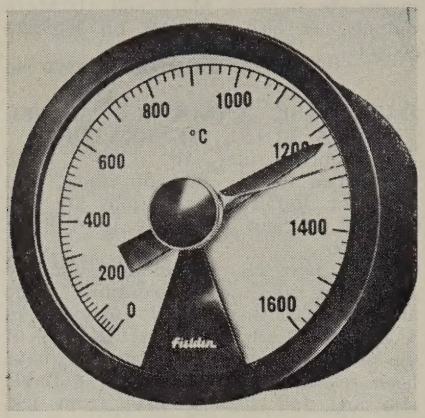


NEW PRODUCTS—*Continued*

REMOTE MEASUREMENT AND CONTROL OF HIGH TEMPERATURES

Transistorised Pyrometer for use with Thermocouples up to 1600°C.

Fielden Electronics Ltd., of Manchester (G.B.), have introduced fully transistorised pyrometers for use with thermocouples at temperatures up to 1600°C.



The new thermocouple instruments can be used as precision indicators or as indicator/controllers. Each has an indicator face 6½ inches in diameter, a clear scale length of 12½ inches and a wedge type pointer making it easy to read from a distance. The pointer is on the same shaft as a precision potentiometer which is automatically balanced by a small friction servomotor, thus eliminating gears and possible back-lash. The potentiometer is energised by direct current stabilised by a zener diode. This also supplies a temperature-sensitive resistance to give automatic and accurate cold-junction compensation. A balanced chopper has been incorporated to give stability against temperature changes.

By using a knob in the centre of the face two precious metal contacts can be set to operate at any point of the scale. They operate a bistable transistor circuit which completely protects them and prevents arcing at the relay contacts. Accuracy of control is of the order of 0.1%. An anticipatory control version is available in which power is switched off slightly before the preset point is reached.

ENQUIRY CARD 42

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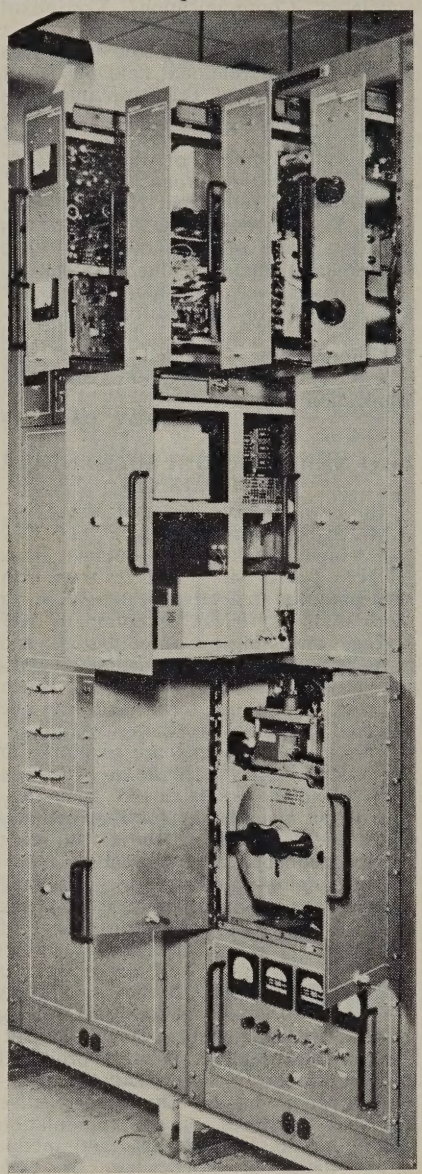
Illustration below shows the High Power Transponder Cabinet of the Wilcox 496A DME System which has been ordered from AWA for installation at Auckland and Christchurch International Airports.



A.W.A. GETS AIRPORT CONTRACT

Amalgamated Wireless (Australasia) N.Z. Limited has been awarded a contract to supply WILCOX Dual Distance Measuring Equipment for installation at Nandi, Auckland and Christchurch International Airports.

These DME Ground Stations which operate on 1,000 M/Cs meet the International Civil Aviation Organisation requirements.

DME is an electronic system which measures the distance of an aircraft from a station on the ground. Basically the system operates by transmitting a signal from an aircraft to the ground station which, in turn, replies. The time taken to exchange these signals is measured accurately, and from this and the known speed of the radio wave, the distance is automatically computed. This computed distance is then indicated to the pilot in nautical miles on a circular dial-needle pointer instrument or an odometer presentation.

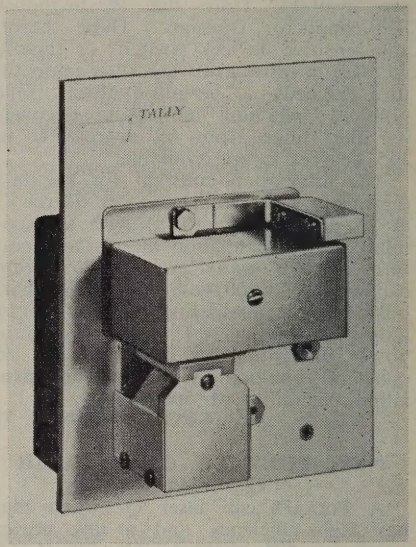
ENQUIRY CARD 43

* * *

LOW COST PERFORATED TAPE READER ANNOUNCED

A low cost, medium speed perforated tape reader has been introduced by Tally Corporation, Seattle, Washington.

The new reader operates at up to 25 characters per second asynchronously and 55 to 60 characters per second synchronously.



Other features of the Model 625 Uni-directional perforated tape reader include rate controlled by external equipment or from tape advance mechanism feedback controls. Form C switching provides positive hole-no-hole circuit discipline and allows introduction of bit accountability techniques. The new instrument reads 5, 6, 7 or 8 channels without modification. It can be slaved to any other device operating at speeds up to 25 characters per second.

Chief applications for the Model 625 include code converter, typewriter, digital to analog converter, data processing and numerical control systems.

ENQUIRY CARD 45

A SIMPLE CONVERTER

Continued from page 12

Constructors using a lesser grade of transformer core material may need to take special precautions to limit "switching" spikes and it is suggested that a commercially wound transformer be obtained in cases where the core material is in doubt.

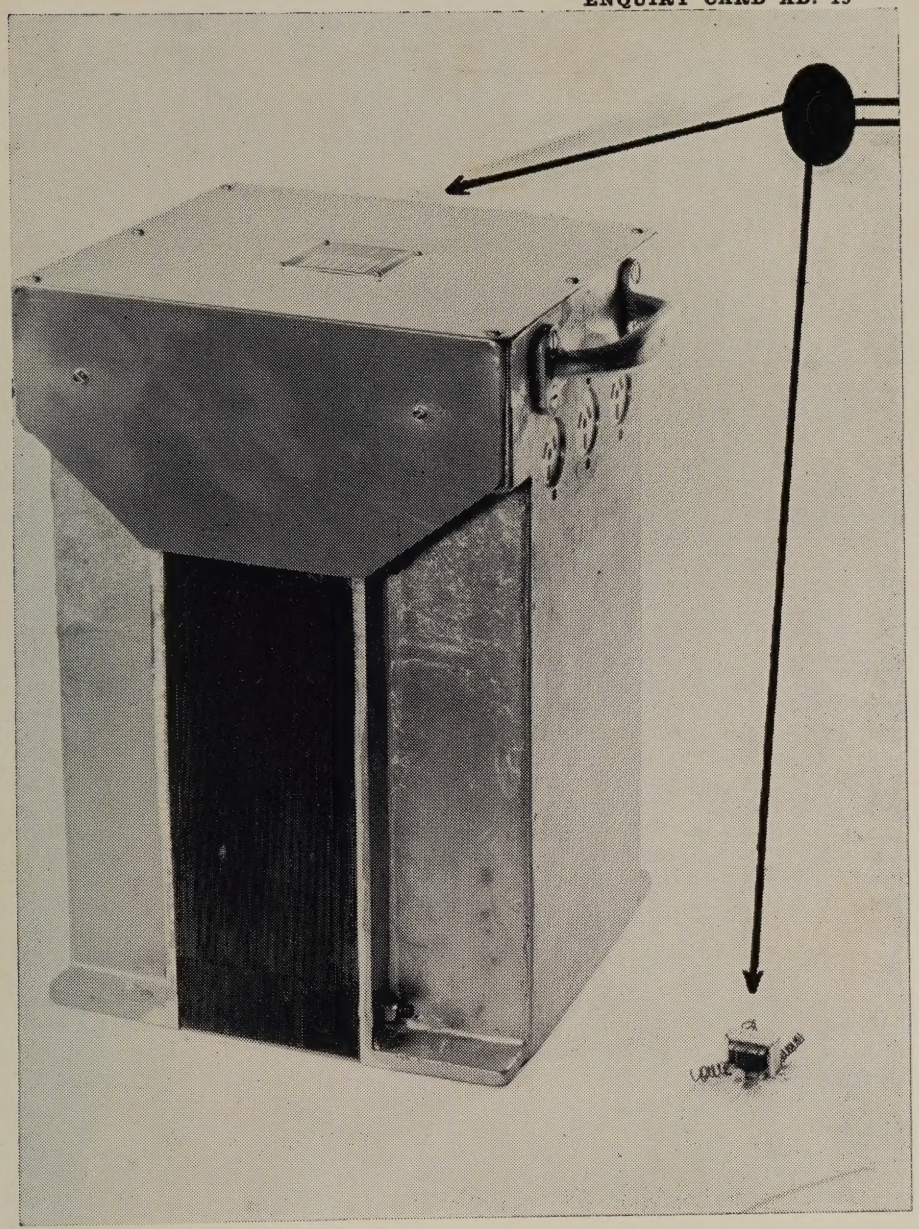
(Editor's Note: Auckland Transformer Co. Ltd.'s transformer design R2591 is suitable.)

Notice to Readers

Correction to circuit on page 14, August 1964, "Transistorised Grid Dip Oscillator." The circuit shows a wire joining Pin No. 3 of the coil plug to the lead running between the positive terminal of the meter and Pin 2 of the plug. This should, of course, be removed from the circuit. We regret this error in the published circuit.

Printed for the publishers, The Magazine Press Ltd., Lumley House, 10 High St., Auckland, C.1, by Farrell Printing Ltd., 69 Carr Rd., Mt. Roskill, Auckland.

ENQUIRY CARD AD. 19



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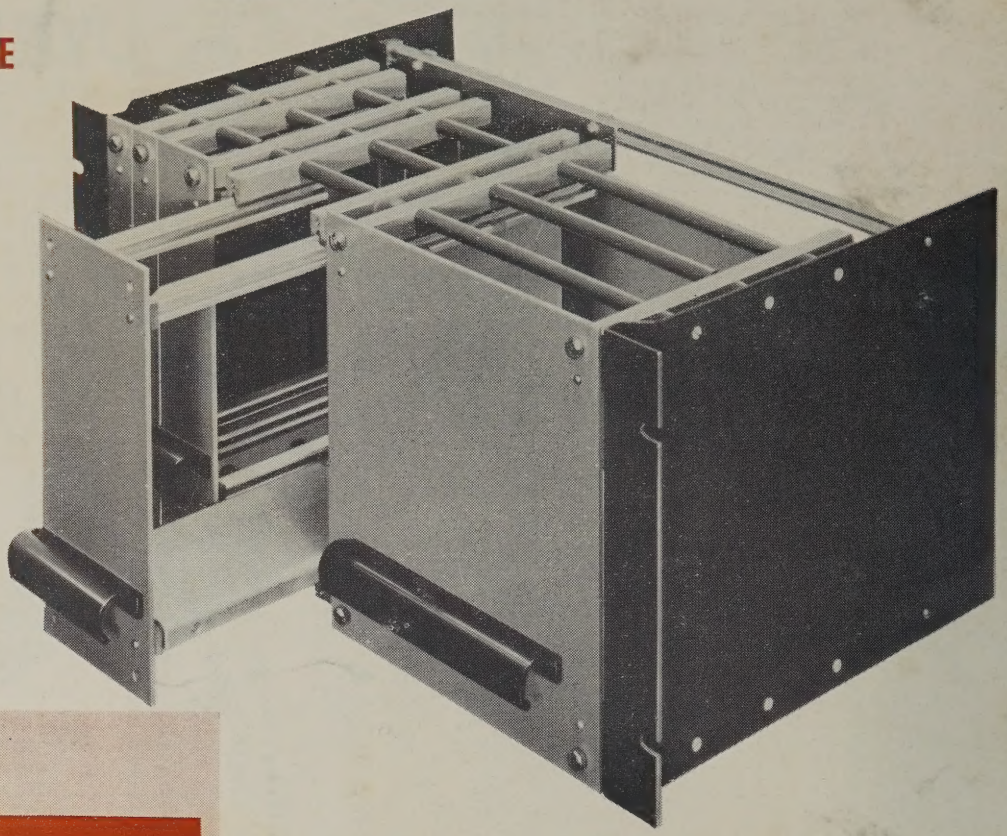
THE MOST VERSATILE MODULE UNIT ASSEMBLY YET DEVISED



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